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Observations of humidity, temperature and wind at Idris 23rd May - 2nd June, 1956

by

N. C. Helliwell and J. K. Mackenzie

(Meteorological Office)

AIR MINISTRY

METEOROLOGICAL RESEARCH COMMITTEE

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1. Summary

Seventeen flights were made from 23rd May to 2nd June, 1956 to investigate the humidity of the atmosphere at altitude over Idris in Tripolitania. Two types of flight were made: those over the desert to the south at heights between 35,000 and 48,000 ft. and ascents over Idris in which measurements were made at selected levels up to 48,000 ft.

The first type of flight is treated synoptically and an attempt is made to explain the values of frost point found. The second type of flight is also treated synoptically. Over some eight or nine observations during the period, the mean frost point at 48,000 ft. over Idris was found to be -82.6°C compared to -82°C over Southern England, but the mean values over Idris show more moisture at all lower altitudes than do the means over Southern England for 1954 and 1955.

2. Introduction

It was decided in April, 1956 that Canberra W.J.582 of the Meteorological Research Flight should go to R.A.F. Station, Idris (32°40'N., 13°10'E.) to be used for measurements of humidity, temperature and wind. It was also intended to measure the ozone content of the air at altitude, but the results were so anomalous that they have been made the subject of a separate report which also assesses the value of all the measurements made by the Flight this year, using the same apparatus abroad and at home.

Alongside Fig. 10 of this report there are a number of conversion tables, scales, etc., which are useful in reading the text.

3. Flight planning

The plan of the flights was to make measurements of humidity, temperature, ozone and wind

(1) during ascents over Idris to 48,000 ft. or maximum altitude

(2) during flights to the south of Idris, outbound leg at varying levels, inbound leg at maximum altitude

(3) during flights to the north similar to those to the south but with shorter legs at four different altitudes.

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Owing to the fact that most of the stand-by equipment carried to Idris by R.A.F. Transport Command was not unloaded at Idris, the flight plan was modified and on the first few flights humidity, temperature and wind measurements only were made. The hygrometer became unserviceable on three occasions due to the high temperature reached in the aircraft cabin on the ground and the consequent breaking of the pressure-seals. The flights were as listed below in Table 1.

Table 1. Flights from R.A.F. Idris

Date	Type of flight	No. of flight	Observations taken and remarks
23rd May	Odiham to Idris	1	Frost points, wind, temperature
a.m. 24th May	High level ascent over Idris	2	Frost points, wind, temperature
p.m. 24th May	"	3	Two values of frost points. Hygrometer unserviceable
a.m. 25th May	"	4	Hygrometer unserviceable. Temperature to 46,000 ft.
p.m. 25th May	"	5	Frost points, wind and temperature to 48,000 ft.
a.m. 26th May	Flight to the south of Idris	6	Hygrometer unserviceable. Some winds and temperatures
p.m. 26th May	High level ascent over Idris	7	Frost points, wind and temperature
a.m. 27th May	Flight to 24°N. and return to Idris	8	Frost points, wind and temperature
p.m. 27th May	High level ascent over Idris	9	Frost points, wind and temperature
a.m. 29th May	Flight to 23°N. and return to Idris	10	Frost points, ozone, wind and temperature
p.m. 29th May	High level ascent over Idris	11	Frost points, wind and temperature
a.m. and p.m. 30th May	"	12 13	Frost points, wind and temperature
a.m. and p.m. 31st May	"	14 15	Ozone was measured on the morning flights
a.m. 1st June	Flight to 23°N. and return	16	Wind, temperature and ozone
a.m. 2nd June	Idris to Tangmere	17	Wind and temperature

4. Instruments

Frost point was measured by the Dobson-Brewer pressurised frost point hygrometer. Temperature was measured by flat-plate thermometer and standard Meteorological Office balanced bridge. The results are presented here in comparison with winds found by the radio sonde at Wheelus Field, some 17 miles NNE. of Idris. All readings of height, airspeed and course were taken from the standard aircraft altimeter, airspeed meter and gyrocompass.

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5. High level ascents only

Mean temperatures and frost points

Fig. 1 and Table 2 compare mean temperatures, mean frost points and relative humidities derived from them, found at Idris during May, 1956 with the overall means for the two years 1954 and 1955 over Southern England (2) and with the means for those ascents over Southern England which showed a tropopause at 38,000 ft. or above.

Table 2. Mean temperatures and frost points (degrees C)

Height ft.	No. of cases at Idris	Mean temperature May, 1956 Idris	Mean temperature 1954-55 England	Mean temperature 1954-55 High trop. England	No. of cases at Idris	Frost points May, 1956 Idris	Frost points 1954-55 England	Frost points 1954-55 High trop. England	Relative humidity % May, 1956 Idris	Relative humidity % 1954-55 England
5,000	4	+24.8	+ 1.4	-	3	- 5.8	- 8.5	-	12.5	45
10,000	11	+ 9.8	- 6.4	-	7	-10.6	-14.7	-	22	49
15,000	6	- 4.1	-15.6	-	3	-13.5	-29.5	-	46	26
20,000	12	-15.95	-25.8	-22.6	9	-30.6	-37.1	-31.9	25	31
25,000	11	-27.1	-37.3	-33.9	9	-41.6	-47.6	-43.8	31.5	30
30,000	12	-39.6	-47.4	-46.7	9	-46.2	-56.6	-53.5	46	32
34,000	9	-49.5	-54.9	-55.7	9	-55.0	-61.6	-60.6	51	27
36,000	7	-54.2	-56.1	-59.7	7	-59.0	-67.6	-64.8	50	20
40,000	12	-59.3	-55.2	-63.4	10	-71.1	-75.4	-72.9	18.8	5.4
44,000	10	-61.3	-53.4	-58.0	8	-78.6	-80.3	-80.8	8.8	2.3
46,000	9	-63.8	-52.8	-57.5	7	-80.4	-81.4	-82.3	8	1.8
48,000	11	-65.9	-53.1	-56.8	8	-82.6	-82.0	-83.0	4.7	1.6

From Fig.1 it can be seen that the mean temperature difference between Idris and the south of England falls from 25°C at 5,000 ft. to almost zero at 38,000 ft. At Idris the mean height of the tropopause is 38,600 ft., and there is a cooling above 44,000 ft. presumably towards the tropical tropopause which is believed to lie between 50,000 and 55,000 ft., whereas over Southern England the temperature, in the two-year mean, rises slightly in the stratosphere between 38,000 ft. and 50,000 ft.

Table 3 shows the heights of clouds and haze observed during the ascents.

Table 3

Cirrus, altocumulus and haze tops and bases, with tropopause height on high level ascents over Idris

Date	Flight no.	Haze top	Altocumulus base	Altocumulus top	Cirrus base	Cirrus top	Tropopause ht.(ft.) 1st	Tropopause ht.(ft.) 2nd
a.m. 24th May	2	18,000	18,000	22,000	34,000	34,200	38,000	-
p.m. 24th May	3	17,000	16,500	19,000	33,500	34,000	-	-
a.m. 25th May	4	-	-	-	33,500	34,000	-	-
p.m. 25th May	5	19,000	-	-	31,500	34,000	36,000	-
a.m. 26th May	6	14,000	-	-	31,500	-	-	-
p.m. 26th May	7	20,000	-	-	27,000	38,500	38,000	-
a.m. 27th May	8	15,000	-	-	-	-	-	-
p.m. 27th May	9	18,500	16,000	18,500	-	-	38,000	42,000
a.m. 29th May	10	19,500	-	-	-	-	-	-
p.m. 29th May	11	19,500	-	-	-	-	42,000	-
a.m. 30th May	12	19,500	-	-	30,000	-	40,000	-
p.m. 30th May	13	18,000	-	-	30,000	-	39,000	-
a.m. 31st May	14	18,000	-	-	30,000	38,000	38,000	-
p.m. 31st May	15	21,500	-	-	30,000	42,000	38,000	-
	Mean	18,300	-	-			38,600	

The mixing ratio as indicated by the frost point decreases only slightly with increasing height up to 15,000 ft., but at 20,000 ft. it has fallen to about a quarter of the value at 15,000 ft. This decrease is no doubt associated with the haze top, the mean height of which is 18,000 ft. The air remains dry from 20,000 to 30,000 ft., as shown by the absence of cloud and the low frost points. Above 30,000 ft., however, cirrus cloud is reported on 10 of the 14 flights and this is reflected in the mean frost point and relative humidity figures between 30,000 and 38,000 ft. where there is a layer of high relative humidity. Above 40,000 ft. the frost point falls somewhat less rapidly and in the mean reaches a value of -82.6°C at 48,000 ft.

Although the humidity structure of the stratosphere at Idris resembles that over Southern England the amount of moisture in gm/kgm is a little greater at Idris and the relative humidity is three or more times as great.

A complete list of the ascents and the observations obtained are given in Table 4 and the observations are plotted in Fig. 2 to 10. Each of the long flights at fixed levels to examine humidity variation in the horizontal is described in a later section.

5.1 Notes on individual ascents

Flight 2. As can be seen from Fig. 2 there is fairly close agreement in the lower layers between the aircraft ascent and the radio sonde ascent made some seven hours earlier. Between 30,000 ft. and 40,000 ft. the frost points and the thin layer of cirrus are mutually consistent. At the tropopause (38,000 ft.) there is a relative humidity of 50 per cent but above this level it falls sharply to about 15 per cent and remains at this value to 46,000 ft. although the frost point continues to decrease at about 1°C per 1,000 ft. At 48,000 ft. the relative humidity is about 10 per cent and the frost point appears to have decreased sharply although small (1°C) errors at 46,000 ft. and 48,000 ft. may have accentuated the sharpness of the fall off.

There is quite close agreement between the radio sonde winds and those obtained by the observer in the aircraft, the general wind direction in the stratosphere being south-west.

Flights 5, 7 and 9 are shown in Fig. 3, 4 and 5. They generally show the same type of air mass in the stratosphere as Flight 2. The agreement with the radio sonde data is generally close except, in some cases, for the frost points.

Flight 11. In Fig. 6 the measurements of humidity, temperature and wind made by the aircraft are compared with those made by radio sonde. Once again there is quite close agreement in the lower levels, but above 20,000 ft. there is a difference between the temperatures, not very large but remarkably constant. The high relative humidities, the presence of cirrus, and the low thermal stability, suggest that some ascent was taking place in the upper troposphere. The same inference can be drawn from a consideration of the changes in temperature and frost point which will result from raising the air between 250 and 150 mb. - as represented by Fig. 5 - through 20 mb., when it will be found that the new curves approximate very closely to those of Fig. 6. The north-west winds shown by the aircraft ascent are consistent with the winds found by radio sonde methods.

Fig. 7 shows the newly formed high tropopause and Fig. 8-10 show a gradual decrease in its height.

6. Long flights at constant altitude and weather sequence during the period

6.1 Flight 1. Odiham to Idris 23rd May, 1956

The flight was made at 40,000 ft. rising to 42,000 ft. to the south, and the details can be found on Fig. 12.

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The general synoptic situation at 0900 G.M.T. (Fig. 11) showed a strong ridge over Norway and a weak col over Southern England ahead of an eastward moving frontal system. There was a shallow depression over Germany and Italy and a depression off the coast of Spain was moving east. Associated with each of these depressions was a cold front and both these fronts were moving along the North African coast, one in the vicinity of Algiers, the other near Tunis. Observations from the Sahara indicate the seasonal low pressure area to the south of Idris. Outbreaks of rain were reported over Southern France. Weather over England on take-off was fine but hazy, with some small cumulus, and at Idris the weather was fine with 3/8 of cirrus and altocumulus.

At 0300 G.M.T. the 200 mb. flow shown in Fig. 12 was divided, with a strong south-westerly flow to the north of the British Isles and a strong west-south-westerly flow over the Southern Mediterranean and North Africa. From 5°W. to 15°E. and roughly between 55°N. and 40°N. there was a weak sinusoidal flow with the principal trough-axis at about 2°W. and the ridge between 5 and 10°E.

The 200 mb. flow is superimposed on the same map as the flight observations in Fig. 12 which shows the variation of wind field very clearly, with light winds in the north changing to strong westerlies in the south. These strong winds in the south are probably associated with the sub-tropical jet stream. South of 45°N. there is very close agreement between the observed winds of the flight and those shown by the contour chart. Presumably the differences between the observed winds in the north and those shown on the contour chart are due to the movement of the trough at 2°W. to a position further east during the five hours between the observations on the chart and those taken in the aeroplane: they may also be due to the difference between the wind at the height of the contour map and the wind at the height of the aircraft.

At 40,000 to 42,000 ft. temperatures gradually decreased southwards from -50°C at 40°N. to -60°C at 34°N., but it would seem that the tropopause was never crossed during the flight (except on ascent and descent) although it is possible that some form of discontinuity was encountered between 0945 and 1000 G.M.T. at 42,000 ft. where there is a sharp change of temperature. The tropopause chart for 1500 G.M.T. published in the Daily Aerological Report likewise suggests that the tropopause was not crossed in level flight.

Frost points remained generally steady at -77°C until 40°N. was reached and then there was a gradual increase to -73°C at 35°N. The inaccuracy of the measurements at this altitude makes it extremely difficult to state whether this increase is real or not. However, the variation of frost point with latitude seems to have been rather small on this day and the pattern obtained in the south conforms generally with previous analyses by Murray (5) on the variation of frost point in the vicinity of jet streams.

Cloud conditions on the flight showed much stratocumulus over Northern France and a general increase in the height of cloud tops southwards with broken cirrus layers over the south of France and over the Mediterranean. The cirrus persisted and at 34°N. the top of the thin layer of cirrus was 34,000 ft. with 3/8 of altocumulus below, between 22,000 ft. and 18,000 ft.

6.2 Weather 23rd May-27th May at Idris

During the day of 23rd May the depression off the Spanish coast moved east and the area of low pressure over the Sahara extended to the east and north. By 0600 G.M.T. on 24th May both these depressions were ill-defined but a weak frontal system was moving east over Algeria. The cirrus cloud increased to 5/8 at Idris but cleared by nightfall. The 200 mb. flow remained south-westerly over Tripolitania with ridging to the east which resulted in north-westerly winds over Cyrenaica. The flows at 700, 500 and 300 mb. were similar in character to this with high contours over the Sahara. The upper ridge moved slowly westwards and although there are south-westerly winds at 200 mb. at 0300 G.M.T. on 27th May the flow at lower levels became west to north-west.

The synoptic situation at the surface during this period was fairly stable with a ridge established over Algeria in the rear of a depression which moved eastward from the Spanish coast (Fig. 4). This ridge moved east and by 0600 G.M.T. on the 26th was east of Idris with a depression over Algeria and a general area of lower pressure to the south over the Sahara. This situation was substantially unchanged for Flight 8 on 27th May but before detail is given of this flight it is perhaps relevant to remark that the three successful aircraft ascents made during this period (Fig. 2, 3, 4) show similar features of structure. The progressive slow ascent at levels between 300 mb. and the tropopause can be quite easily followed in successive soundings and there is a suggestion of subsidence occurring in the lower stratosphere at the same time. By the afternoon of 27th May the character of the ascent had changed and there was no longer the very high humidity at the tropopause. The wind direction was westerly at all the levels for which charts are drawn, showing a distinct veer from the previous day's soundings: these facts suggest that the steady type of flow which persisted during the preceding four days was being destroyed and a different flow was about to be established.

6.3 Flight 8 to 24°N. from Idris 27th May, 1956

This flight was made due south from Idris at 35,000 ft. to 24°N. and returned at 45,000 ft., slowly climbing to 48,000 ft. at 33°N. over Idris. The results are presented diagrammatically in Fig. 13 and complete tabulations are made in Table 5. (In Fig. 13, 15 and 20 winds are plotted in the usual way with North at the top of the page).

At 0600 G.M.T. there was a depression over north-west Spain and an associated cold front in the vicinity of Algiers with a trough over Tunisia and a slight ridge over Libya. The weather at Idris was fine with 1/8 of cirrus during the day.

The flow at 0300 G.M.T. at 200 mb. is shown in Fig. 14. There was a jet stream from west-south-west, 45 kt., over Morocco. These winds became westerly during the course of the day. The flow pattern at 0300 G.M.T. for the 700, 500 and 300 mb. contour surfaces was anticyclonic with light or moderate winds. This is borne out by the data obtained by the aircraft during the climb. To the south of Idris there was light westerly flow with anticyclonic curvature at 200 mb. although no wind sounding was available at 0300 G.M.T. to confirm this.

The wind field obtained during the flight suggests that the eastern edge of an anticyclonic circulation was encountered to 26°N., but that south of this there was a recurrence of north-westerly winds. However, these winds are all in the range 10 to 20 kt. and such low speeds are difficult to measure by observations made in a fast-moving aircraft.

The flow in the high troposphere (and possibly in the inter-tropopause regions) between 45,000 and 48,000 ft. is south-westerly and the winds strengthen from about 20 kt. at 23°N. to 40 to 50 kt. at 30°N.

The temperature at 35,000 ft. increases southwards. Between 45,000 and 48,000 ft. there is little or no change of temperature, which suggests an isothermal layer, and the increase in wind at 45,000 ft. over that at 35,000 ft. suggests a warmer layer of air to the south-east between these levels.

At 35,000 ft. there is a fairly uniform frost point of -68°C between 27°N. and 23°N. but there is a gradient of frost point from -62°C at 32°N. to -68°C at 27°N.

At 45,000 ft. the frost point is -80°C at 26°N., and at 28°N. the frost point at 46,000 ft. is -76°C. This is a surprising increase of about 4°C., since it would be expected that the frost point at 46,000 ft. would be the same as or slightly lower than at 45,000 ft. This apparent jump of frost point is confirmed by the next observation of -74°C at 29°N. The frost point was steady at -73°C for three successive observations and then decreased to a value of -85°C at

/31°N.

31°N. Although these observations were not made in level flight it is reasonable to suppose that between 27°N. and 30°N. there was a great current of moister air which was moving north-east.

6.4 Weather 27th May to 29th May at Idris

The depression over Algeria on 27th May developed during the course of the day and a ridge extending southwards from an area of high pressure over Sicily was maintained over Tripoli. By 1800 G.M.T. on 28th May the ridge progressed to the east and during the night a trough moved steadily eastwards and began to affect the Idris area by 0600 G.M.T. on 29th May. The weather at Idris was fine on 27th but the trough caused dense cirrus by 0001 G.M.T. on the 29th May.

The upper flow at Idris was westerly at all levels and wind speeds were 10 to 20 kt. at lower levels. The sub-tropical jet stream was south-westerly and located over Morocco and a ridge formed at all levels at about 10°E. during the night 27th-28th causing a north-westerly flow to persist at all levels until the 31st May. Winds reached 50 to 60 kt. at 200 mb. but generally at higher pressures (300, 500, 700 mb.) winds of 20 to 40 kt. were predominant. In the air to the east of the ridge the ascents show marked differences from those ascents found in the south-westerly flow and this is probably best illustrated by Fig. 5 and 6. Above 40,000 ft. the temperature was 5°C colder in the north-westerly airstream than in the south-westerly and frost points were 3° to 5°C higher.

6.5 Flight 10. Idris to 23°N. and return 29th May, 1956

Fig. 15 shows graphically the flight made to 23°N. at 40,000 ft. with the return at 45,000 ft. to 48,000 ft. and the results are tabulated in Table 6.

The synoptic situation at 0600 G.M.T. showed a surface depression at 25°N. 5°E. with a shallow trough extending northwards over Algeria and into the Mediterranean (Fig. 17). The 700, 500, 300 and 200 mb. flows show a ridge near 10°E. Over Morocco and Spain there was a south-westerly jet stream, and over Cyrenaica north-westerly winds. No wind information is available over the Sahara but at 200 mb. the contours (Fig. 16) suggest lighter winds with anticyclonic circulation at 10°E. between 30°N. and 25°N.

The winds observed at 40,000 ft. (Fig. 15) confirm the flow-pattern deduced from synoptic data. There were uniform northerly winds at 30°N. but these became north-easterly at 24°N. At higher altitudes the north-westerly winds persisted with speeds of 20 to 30 kt. except for a band at 45,000 ft. at 25°N. and 26°N. where the speeds were about 5 kt. Temperature was steady throughout the flight at about -60°C at 40,000 ft. but rose to -57°C at 23°N. The return flight was carried out in more or less isothermal conditions with temperatures between -64°C and -66°C.

The frost point at 40,000 ft. was constant at about -74°C although one observation at 24°N. was 4°C warmer: the exact cause of this is unknown. On the return journey frost points were 1°C or 2°C higher than those found later in the day over Idris but are sufficiently near to the values to suggest that the air was homogeneous (with respect to its water content) from 33°N. to 23°N.

6.6 Weather 29th May to 2nd June

At 0600 G.M.T. on 29th May there was a depression over the Sahara at 10°E. and a weak ridge to the north-east of Idris. This ridge became dominant, the depression moved slowly southwards, and by 0600 G.M.T. on May 31st the trough, which had been over Algeria on the 29th (para. 6.5), had moved east bringing fresh to moderate winds over Tripolitania and much cirrus during the day. The trough receded quickly during the night and in association with a depression over Italy a cold front moved east across Tunisia, a strong ridge

developing to the west over Algeria. During the next 48 hours this ridge extended eastwards to affect the whole of North Africa to Cyrenaica by the 1st June.

The upper flow became westerly as the high contour cells over the Sahara at 700, 500 and 300 mb. moved east and a trough moved from the Atlantic with a cut-off low at these levels moving across the central Mediterranean. At 200 mb. the sub-tropical jet stream gradually backed to west over Morocco and extended along the coast of North Africa with the ridge at 10°E. receding southwards.

During this period four ascents were made. All these ascents show similar characteristics and are described in another section. The last of the series of flights to 24°N. was made on 1st June and it was possible to measure only temperature and wind. By this time the 200 mb. flow was westerly and the surface trough extending to the north-east over Idris had begun to recede. (Fig. 18 and 19.) Measurements were taken at two-minute intervals and are tabulated in Table 7. Fig. 20 is a diagrammatic representation of a selection of the observations. At 40,000 ft. winds gradually backed from west-north-west (20 kt.) to become light (5 kt.) and variable and although there is a suggestion of a circulation in the more detailed observations, winds became south-west to west at about 20 kt. in the extreme south at 22½°N. On the return journey at 44,000 to 48,000 ft. winds were generally south-west to west at 20 to 30 kt. in the south strengthening to 70 kt. at 31°N. at 48,000 ft. At least three of the winds on this return journey are suspect. These are the ones taken at 0720, 0722 and 0728 G.M.T.

Temperature remained steady at -55°C to -57°C throughout the flight at 42,000 ft. and at 45,000 ft. there was little change of temperature. However, values of temperature were obtained at 46,000 to 48,000 ft. and it is probable that these temperatures were taken in the region where the temperature begins to fall with height until the tropical tropopause is reached.

The lack of data over the Sahara at this period makes synoptic comparison impossible but it is suggested by the observations that there was a slow westerly flow at altitude and this is consistent with the mean circulation pattern obtained at lower altitudes.

6.7 Flight 17. 2nd June, 1956. Idris to Odiham

The data obtained on this flight can be seen in Table 8 and a diagrammatic representation of the observations is given in Fig. 21. The contours for the 200 mb. surface at 0300 G.M.T. on the same day are also superimposed on Fig.21. Fig. 22 is a synoptic chart for 0900 G.M.T.

At 0900 G.M.T. (Fig. 22) a shallow depression existed over Southern Italy and Greece and a ridge extended eastwards along the North African coast from the Azores anticyclone. A second ridge from the anticyclone was over the Low Countries and Germany. A vigorous depression centred to the north of Scotland was moving eastwards and the associated cold front was moving east across Wales and Northern England. Weather at Idris was fine with some altocumulus and there was much cirrus and medium cloud over the Mediterranean clearing at the French coast to 3 to 5 oktas. Variable stratocumulus sheets covered most of France breaking to small amounts to the north, but multilayered cloud associated with the warm sector conditions over England penetrated into the extreme north of France.

The 700, 500, 300 and 200 mb. contour maps show similar features and a description of the 200 mb. contour surface will suffice to describe the general upper flow pattern. A cut-off low in the 200 mb. contours was over Italy and Yugoslavia with a strong flow to the west and south and this was the dominant feature of the chart. North of 55°N. the flow was mainly westerly and so the effect of this cut-off low was to divide the flow, the division occurring over Southern England and Northern France.

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The winds obtained during the flight at 40,000 ft. rising to 42,000 ft. show reasonably good agreement with the 200 mb. contour pattern as regards direction, although the speeds obtained during the flight are somewhat lighter than those obtained six hours earlier at 0300 G.M.T. by radio sonde. It is possible that the cut-off low had edged south-west during the period or that the centre had begun to fill and that the discrepancy of wind is principally due to time lag.

Temperature at 40,000 ft. was -52°C over Tunisia and rose to -48°C towards the centre of the cut-off low but subsequently fell to reach a value of -54°C at the French coast. A further decrease to -56°C was obtained over Southern France but the aircraft climbed to 42,000 ft. before the temperature had steadied. At 42,000 ft. over France the temperature was -59°C to -60°C.

The cloud notes obtained during flight agreed generally with the surface observations of weather taken from synoptic charts.

The supply of liquid nitrogen was limited and there was none available for 1st and 2nd June so that humidities were not measured on these two days.

7. General discussion

The well-marked increase of frost point associated with decreasing temperature and increasing wind in Flight 1 is typical of the features of the cold-air side of jet streams in England investigated by Murray (3) and the observations of temperature and wind on Flight 17 have the same characteristics. Hence it would appear that, as far as this evidence goes, the sub-tropical jet stream is similar in structure to jet streams found in association with extra-tropical cyclones. The position of the jet stream relative to Idris (i.e. near or to the north) would suggest that the ascents at Idris resembled those over Southern England in anticyclonic (high tropopause) conditions. Hence in Table 2 the means for England when the tropopause is at 38,000 ft. or above should be more comparable with those for Idris than the overall means for England. This is indeed found to be so up to 40,000 ft. but above this level there is a drier stratosphere over anticyclones in England than during this period over Idris. The mean humidity of this series of flights at Idris between 30,000 and 40,000 ft. is greater than the two-year mean over England when air masses with high tropopauses alone are considered and this higher humidity is accompanied by cirrus layers over Idris at these levels.

In the main, however, it appears that the frost point between 40,000 and 50,000 ft. over Idris differs only slightly from that found over Southern England. Local variations (including the influx of moist air from the south at levels near or just above 40,000 ft.) are well within the variations of frost point found over Southern England. The higher relative humidities are almost entirely an effect of the lower temperatures.

Little can be deduced from the three flights over the desert. The wind flow in the upper air at this season is believed to be predominantly westerly, and to be modified by the passage of troughs and ridges in much the same way as in temperate latitudes. The observations made on these flights are compatible with this view. At 35,000 and 40,000 ft. the temperatures increased towards the south, but at 46,000-48,000 ft. there was little variation. It is noticeable that at 35,000 ft., on the 27th, the frost point fell towards the south, whereas at 40,000 ft. on the 29th there was no such variation. The one striking anomaly was the narrow band of higher frost points and slightly lower temperatures encountered in 29-30°N. at 46,000, 48,000 ft. on May 27th: but it is impossible to assess the significance of this, on the evidence available.

/8.

8. References

1. Helliwell, N.C. and Mackenzie, J.K. 1956 Meteorological Research Papers, Air Ministry London, No. 979.

2. Helliwell, N.C., Mackenzie, J.K. and Kerley, M.J. 1956 Meteorological Research Papers, Air Ministry, London, No. 976.

3. Murray, R. 1956 Geophysical Memoirs No. 97. Air Ministry, London.

Table 4

High level ascents over Idris 23rd May, 1956 - 1st June, 1956

Date			24th May, 1956				24th May, 1956		
Flight No.			2				3		
Time G.M.T.			0638-0845				1335-1410		
Height ft.	ICAN Press. mb.	Temp. °C	Frost Point °C	Wind Dirn. deg.	Wind Speed kt.	Temp. °C	Frost Point °C	Wind Dirn. deg.	Wind Speed kt.
5,000	843	+23.6	-12.5	228	23	-	-	-	-
10,000	697	+10.2	-14.5	215	27	+9.0	-11.5	214	25
15,000	572	-3.3	-10.5	214	36	-	-	-	-
20,000	465	-17.8	-28.0	235	25	-16.0	-31.0	231	29
25,000	376	-27.5	-38.0	246	37	-	-	-	-
30,000	301	-39.8	-48.5	244	33	-	-	-	-
32,000	274	-45.3	-54.0	233	51	-	-	-	-
34,000	250	-48.9	-49.5	241	50	-	-	-	-
36,000	227	-52.0	-59.0	259	60	-	-	-	-
38,000	206	-57.2	-62.0	259	67	-	-	-	-
40,000	187	-58.9	-72.0	255	71	-	-	-	-
42,000	170	-59.8	-75.5	267	56	-	-	-	-
44,000	155	-62.6	-77.5	245	55	-	-	-	-
46,000	140	-65.0	-78.0	246	60	-	-	-	-
48,000	127	-67.3	-83.0	233	60	-	-	-	-

Date			25th May, 1956				25th May, 1956		
Flight No.			4				5		
Time G.M.T.			0620-0735				1250-1450		
5,000	843	-	-	-	-	-	-	-	-
10,000	697	+7.9	-	199	48	+8.7	-24.0	204	25
15,000	572	-	-	-	-	-	-	-	-
20,000	465	-17.0	-	228	40	-17.4	-39.0	-	-
25,000	376	-	-	-	-	-25.2	-47.0	235	45
30,000	301	-38.9	-	-	-	-39.5	-46.0	245	53
32,000	274	-	-	-	-	-44.2	-46.0	227	62
34,000	250	-	-	-	-	-49.2	-52.0	246	70
36,000	227	-	-	-	-	-53.9	-58.5	248	60
38,000	206	-	-	-	-	-55.5	-69.0	244	78
40,000	187	-57.7	-	251	56	-57.4	-73.0	239	60
42,000	170	-59.6	-	-	-	-59.8	-76.0	239	65
44,000	155	-60.1	-	-	-	-60.5	-83.0	257	53
46,000	140	-62.4	-	239	67	-64.6	-	248	50
48,000	127	-	-	-	-	-65.7	-	260	35

Date			26th May, 1956				26th May, 1956		
Flight No.			6						
Time G.M.T.			0608-0700				1239-1403		
5,000	843	-	-	-	-	-	-	-	-
10,000	697	+9.6	-	225	21	+9.1	-7.5	195	21
15,000	572	-	-	-	-	-	-	-	-
20,000	465	-14.5	-	-	-	-14.4	-42.0	230	20
25,000	376	-26.4	-	234	37	-28.1	-43.5	279	19
30,000	301	-40.2	-	228	30	-40.0	-46.5	217	37
32,000	274	-	-	-	-	-	-	-	-
34,000	250	-	-	-	-	-48.4	-54.5	229	40
36,000	227	-	-	-	-	-	-	-	-
38,000	206	-	-	-	-	-60.7	-60.5	248	40
40,000	187	-	-	-	-	-55.9	-72.5	-	-
42,000	170	-	-	-	-	-59.5	-75.5	246	54
44,000	155	-	-	-	-	-60.9	-78.5	224	42
46,000	140	-	-	-	-	-64.2	-81.5	237	47
48,000	127	-	-	-	-	-66.6	-83.0	239	50

Table 4

Date			27th May, 1956				29th May, 1956		
Flight No.			9				11		
Time G.M.T.			1235-1351				1240-1420		
Height ft.	ICAN Press. mb.	Temp. °C	Frost Point °C	Wind Dirn. deg.	Wind Speed ft.	Temp. °C	Frost Point °C	Wind Dirn. deg.	Wind Speed ft.
5,000	843	-	-	-	-	+25.2	-2.0	229	07
10,000	697	+9.5	-4.5	212	24	+12.4	-6.0	303	12
15,000	572	-	-	-	-	-4.2	-18.0	348	25
20,000	465	-17.2	-32.0	065	06	-16.4	-21.0	334	23
25,000	376	-26.9	-49.5	037	05	-26.5	-41.5	300	32
30,000	301	-39.5	-46.0	293	15	-39.8	-43.0	327	47
32,000	274	-45.4	-50.0	294	28	-44.2	-47.0	313	42
34,000	250	-49.8	-60.0	315	25	-49.8	-54.5	329	29
36,000	227	-55.0	-62.0	344	32	-54.1	-62.5	311	37
38,000	206	-58.8	-68.5	307	19	-59.5	-64.0	316	38
40,000	187	-58.7	-73.5	329	20	-62.7	-67.0	314	31
42,000	170	-61.6	-75.5	238	22	-65.0	-71.0	303	33
44,000	155	-58.6	-79.5	269	33	-65.4	-73.5	310	37
46,000	140	-62.8	-81.0	254	43	-65.8	-77.5	320	57
48,000	127	-65.8	-82.0	272	28	-66.5	-79.5	329	40

Date			30th May, 1956				30th May, 1956		
Flight No.			12				13		
Time G.M.T.			0542-0750				0900-1050		
5,000	843	-	-	-	-	+24	-3.0	315	15
10,000	697	+10.3	-	333	11	+10.9	-6.0	317	07
15,000	572	-	-	-	-	-4.2	-12.0	303	22
20,000	465	-15.6	-23.0	317	12	-15.5	-27.5	332	16
25,000	376	-26.9	-39.0	313	20	-26.5	-37.5	286	20
30,000	301	-39.6	-48.0	326	49	-39.2	-48.0	319	47
32,000	274	-44.4	-52.0	324	55	-43.6	-	-	-
34,000	250	-49.2	-57.0	312	52	-49.7	-55.0	317	49
36,000	227	-54.7	-59.5	318	53	-54.6	-	-	-
38,000	206	-58.8	-62.5	318	57	-59.3	-62.5	316	53
40,000	187	-63.3	-66.5	323	48	-61.6	-69.0	308	49
42,000	170	-61.4	-76.0	328	43	-61.0	-74.0	309	40
44,000	155	-61.7	-78.0	321	46	-61.1	-79.0	301	49
46,000	140	-62.3	-82.5	310	61	-64.3	-81.0	303	50
48,000	127	-65.6	-83.5	332	38	-67.4	-83.5	329	30

Date			31st May, 1956				31st May, 1956		
Flight No.			14				15		
Time G.M.T.			0530-0700				0900-1000		
5,000	843	-	-	-	-	-	-	-	-
10,000	697	-	-	-	-	-	-	-	-
15,000	572	-	-	-	-	-	-	-	-
20,000	465	-16.7	-31.5	324	42	-	-	-	-
25,000	376	-26.1	-38.0	292	42	-26.4	-40.5	-	-
30,000	301	-39.9	-43.0	310	40	-39.8	-47.0	303	41
32,000	274	-44.6	-	-	-	-43.5	-	-	-
34,000	250	-50.2	-56.5	304	55	-50.1	-56.0	300	54
36,000	227	-55.2	-58.0	314	48	-54.5	-	-	-
38,000	206	-59.2	-64.5	301	60	-58.5	-69.0	297	50
40,000	187	-59.7	-70.5	322	45	-58.4	-73.0	312	43
42,000	170	-59.8	-76.5	287	47	-59.8	-76.0	267	52
44,000	155	-60.0	-	281	35	-62.3	-79.5	285	50
46,000	140	-62.9	-81.5	273	53	-	-	-	-
48,000	127	-65.3	-	291	41	-	-	-	-

Table 5

Flight 8. 27th May, 1956

Idris to 24°N. and return. Longitude 13°E. ±15'

Time G.M.T.	Height ft.	Pressure mb.	Temp. °C	Frost Point °C	Wind Dirn. deg.	Wind Speed kt.	Remarks
0543	Surface	-	+19.5	-	-	-	Taxying
	1,000	978	+26.4				Climb to 35,000 ft.
	2,000	942	+30.9				No cloud. Haze top
	3,000	908	+30.8				15,000 ft. with very
	5,000	843	+26.4				patchy A.c. and Ci.
	6,000	812	+22.8				to the east
	7,000	782	+20.6				
	13,000	619	+ 0.1				
	15,000	572	- 6.0		165	11	
	20,000	465	-12.9		270	05	
	25,000	376	-31.2		227	12	
	30,000	301	-38.9		290	20	
0616	35,000	238	-52.0		264	17	Much Ci. and As. to E.
0620	35,100	238	-50.8	-62.0	273	08	and N. at these levels
0625	35,100	238	-50.8	-61.0	273	08	
0630	35,200	238	-49.2	-65.0	324	06	
0638	35,200	238	-47.8	-68.0	321	08	Ci. bands have receded
0645	35,100	238	-45.8	-68.0	351	14	
0650	35,200	238	-45.7	-68.0	050	14	
0658	35,250	237	-44.9	-67.0	282	18	
0702	35,100	238	-44.1	-66.0	297	19	
0707	35,100	238	-43.7	-	254	20	
0717	40,200	187	-55.7	-76.0	233	31	) Turning back at
0726	45,400	144	-65.4	-	270	07	) 600 mi. south
0739	45,400	144	-64.4	-	228	23	Southern edge of Ci.
0749	45,400	144	-63.4	-80.0	227	35	which is to N. and E.
0752	45,400	144	-62.7	-	220	39	
0802	46,400	137	-65.7	-76.0	239	30	
0812	46,450	137	-64.6	-74.0	235	50	
0817	46,450	137	-64.8	-73.0	235	53	
0819	47,000	133	-64.5	-73.0	210	44	
0821	48,250	126	-65.8	-73.0	230	38	
0831	48,600	123	-65.5	-85.0	222	41	
0841	48,600	123	-63.7	-85.0	228	45	

Table 6

Flight 10. 29th May, 1956. 0550 to 0905 G.M.T.

Idris to 600 miles south of Idris and return. Longitude 13°E.±15'

Time G.M.T.	Height ft.	Pressure mb.	Temp. °C	Frost Point °C	Wind Dirn. deg.	Wind Speed kt.	Remarks
0613	40,000	187	-61.4	-74.0	344	37	Haze top 18,500 ft.
0616	40,000	187	-60.8	-74.0	344	37	
0624	40,000	187	-60.5	-75.0	355	33	
0634	40,000	187	-60.0	-74.0	357	41	
0637	40,000	187	-60.1	-74.0	357	40	
0645	40,000	187	-60.5	-74.0	003	43	
0650	40,000	187	-60.4	-74.0	021	42	
0659	40,000	187	-60.0	-74.5	026	35	
0703	40,000	187	-59.8	-71.0	022	42	
0707	40,000	187					Slight clear air turbulence
0710	40,000	187	-57.1	-73.0			
	41,000	179	-58.8				Turning back at 600 miles south. Climbing 40,000 to 45,000 ft.
0712	42,000	170	-60.3				
to	43,000	162	-61.7				
0722	44,000	155	-63.0				
	45,000	147	-65.1				
0728	45,000	147	-66.3	-78.0	322	23	
0730	45,000	147	-65.3	-78.5	334	05	
0734	45,000	147	-64.6	-78.0	297	03	
0743	45,000	147	-64.2		326	06	
0751	45,500	144	-65.3	-78.0	330	27	Cirrus on horizon to NW.
0759	46,000	140	-65.4	-80.0	320	21	
0803	46,000	140	-65.8	-80.0	332	32	
0814	46,500	136	-67.4				
0815	47,000	133	-67.3				
0817	47,500	130	-65.9				
0819	48,000	127	-66.2	-83.5	332	21	
0828	48,000	127	-66.9	-82.5	334	25	
0839	48,000	127	-66.6	-81.5	319	38	
0845							Rapid descent. Ci. tops 35,000 ft. base 32,000 ft.

Table 7 Part I

Flight 16. 1st June, 1956. 0530 to 0840 G.M.T.

Idris to 600 n.miles south of Idris and return. Longitude 13°E. ±15'

Time G.M.T.	Height ft.	Pressure mb.	Temp. °C	Wind Dirn. deg.	Wind Speed kt.	Remarks
0557	40,200	186	-56.1	283	38	$\frac{3}{8}$-$\frac{5}{8}$ Cu. base 12,000 ft.
0559	40,100	187	-55.9	273	32	Isolated tops 21,500 ft.
0601	40,000	187	-55.7	284	22	$\frac{1}{8}$ Ci. to east on climb.
0603	40,200	186	-56.8	282	22	No cloud at 120 mi. south of
0605	40,200	186	-57.3	281	22	Idris at 0557 G.M.T.
0608	40,000	187	-57.4	285	20	
0610	40,100	187	-57.5	299	21	
0612	40,200	186	-56.4	300	25	
0614	40,280	185	-57.5	295	20	
0616	40,200	186	-56.5	308	20	
0618	40,200	186	-57.3	286	23	
0620	40,200	186	-57.4	278	15	
0622	40,220	186	-56.8	297	17	
0624	40,200	186	-55.4	301	12	
0626	40,200	186	-56.5	274	20	
0628	40,200	186	-57.1	278	26	
0630	40,100	187	-58.8	260	04	
0632	40,200	186	-58.2	331	08	
0634	40,000	187	-57.8	271	04	
0636	40,000	187	-57.6	327	07	
0638	40,200	186	-57.5	290	11	
0640	40,200	186	-57.5	151	05	
0642	40,200	186	-56.7	051	06	
0644	40,200	186	-57.4	312	05	
0646	40,200	186	-57.6	004	02	
0648	40,200	186	-57.2	032	06	
0650	40,200	186	-56.7	005	06	
0652	40,400	184	-57.2	326	12	Slight clear air turbulence
0654	40,200	186	-57.0	280	11	
0656	40,000	187	-57.9	245	18	
0658	40,000	187	-57.4	223	11	
0700	40,000	187	-57.9	287	15	
0702	40,000	187	-57.7	282	11	
0705	42,000	170	-60.9	253	23	

Table 7 Part II

Flight 16. 1st June, 1956. 0530 to 0840 G.M.T.

Idris to 600 n.mi. south of Idris and return. Longitude 13°E±15'

Time G.M.T.	Height ft.	Pressure mb.	Temp. °C	Wind Dirn. deg.	Wind Speed kt.	Remarks
0708	44,000	155	-62.0	250	27	
0712	45,300	146	-64.9	242	29	
0714	45,200	146	-64.3	246	29	
0716	45,400	145	-64.6	265	11	
0718	45,250	146	-64.2	210	20	
0720	45,250	146	-64.1	178	13	
0722	45,400	145	-64.2	198	13	
0724	45,200	146	-63.8	249	10	
0726	45,200	146	-63.5	255	13	
0728	45,200	146	-63.1	178	12	
0730	45,400	145	-62.7	242	21	
0732	45,100	147	-63.1	230	15	
0734	45,100	147	-62.1	242	20	
0736	45,200	146	-62.6	255	23	
0738	45,300	146	-63.1	267	25	
0740	45,400	145	-63.0	255	22	
0742	45,450	145	-62.8	268	38	
0744	45,200	146	-63.0	269	18	
0746	45,250	146	-63.0	275	29	
0750	46,700	133	-66.6	257	30	
0755	47,600	131	-64.8	240	42	
0757	48,000	127	-65.7	245	32	
0759	48,400	125	-67.7	281	33	
0801	48,400	125	-66.5	249	37	
0803	48,450	125	-66.2	264	49	
0805	48,500	124	-66.5	256	43	
0807	48,400	125	-67.0	247	51	
0809	48,400	125	-66.5	260	55	
0811	48,400	125	-66.0	278	61	
0813	48,400	125	-65.0	267	62	
0815	48,400	125	-65.0	263	63	
0817	48,400	125	-64.7	262	71	
0830	21,500	Descent				135 mi. south of Idris edge of cloud. Top 21,500 ft. Haze top at 21,500 ft.

Table 8 Part I

Flight 17. 2nd June, 1956. 0830 to 1150 G.M.T.

Idris to Tangmere

Time G.M.T.	Height ft.	Pressure mb.	Temp. °C	Wind Dirn. deg.	Wind Speed kt.	Remarks
0857	40,200	185	-52.4	249	82	3/8 cirrus base 28,000 ft. top 35,000 ft. in layers
0859	40,200	185	-52.4	246	85	
0901	41,000	186	-50.3	240	85	
0903	40,250	185	-49.6	233	80	
0905	40,250	185	-51.0	241	64	
0907	40,200	185	-50.0	244	58	
0909	40,200	185	-47.1	247	63	
0911	40,000	187	-50.5	253	48	
0913	40,200	185	-50.8	258	51	
0915	40,400	183	-48.0	265	50	
0917	40,400	183	-48.6	253	42	
0919	40,200	185	-48.6	260	39	
0921	40,400	183	-49.6	259	37	
0923	40,200	185	-49.5	262	31	
0925	40,200	185	-49.0	246	49	
0927	40,200	185	-49.2	255	29	
0929	40,100	186	-49.0	243	39	
0931	40,200	185	-48.5	253	36	Slight clear air turbulence
0933	40,200	185	-48.2	265	21	Slight clear air turbulence
0935	40,200	185	-48.1	261	39	
0937	40,200	185	-48.0	286	25	
0939	40,200	185	-48.5	296	21	
0941	40,200	185	-48.8	271	33	
0943	40,100	186	-50.0	272	24	
0945	40,200	185	-49.5	280	15	
0947	40,000	187	-49.0	329	08	
0949	40,200	185	-48.8	294	18	
0951	40,200	185	-49.6	318	14	
0953	40,200	185	-51.1	303	13	
0955	40,200	185	-51.3	325	25	
0957	40,200	185	-51.3	344	18	
0959	40,200	185	-51.2	350	13	
1001	40,200	185	-52.2	349	15	
1003	40,000	187	-51.5	334	15	
1005	40,100	186	-52.3	356	30	

Table 8 Part II

Flight 17. 2nd June, 1956. 0830 G.M.T.

Idris to Tangmere

Time G.M.T.	Height ft.	Pressure mb.	Temp. °C	Wind Dirn. deg.	Wind Speed kt.	Remarks
1007	40,100	186	-52.4	004	17	
1009	40,000	187	-54.2	319	17	
1011	40,200	185	-53.1	333	15	
1013	40,200	185	-53.4	352	13	
1015	40,100	186	-55.5	013	19	
1017	40,100	186	-54.4	334	06	
1019	40,200	186	-54.0	350	14	Over Marseilles
1021	40,200	185	-53.8	351	14	
1023	40,200	185	-54.2	358	19	
1025	40,200	185	-53.9	006	16	
1027	40,200	185	-56.7	346	27	
1029	40,200	185	-57.6	353	31	
1031	40,200	185	-57.5	013	23	
1033	40,400	184	-55.9	025	06	
1035	40,700	182	-58.5	008	21	
1037	41,300	176	-54.5	345	21	
1039	41,400	175	-55.8	326	20	
1041	41,900	171	-56.6	009	21	
1043	42,200	169	-56.3	319	13	
1045	42,200	169	-56.7	323	19	
1047	42,300	168	-56.8	323	19	
1049	42,300	168	-57.3	323	19	
1051	42,200	169	-61.0	299	11	
1053	42,200	169	-60.4	334	03	
1055	42,000	170	-59.4	-	0	
1057	42,200	169	-59.8	318	12	
1059	42,000	170	-60.1	334	02	
1101	42,000	170	-60.4	299	12	
1103	42,000	170	-59.4	203	07	Cirrus ahead
1105	42,000	170	-59.8	302	08	
1107	41,700	173	-59.5	286	09	
1109	41,700	173	-60.2	286	10	
1111	42,100	170	-60.6	280	23	
1113	42,100	170	-59.3	278	14	
1115	42,000	170	-58.7	282	28	
1117	42,000	170	-57.6	239	16	

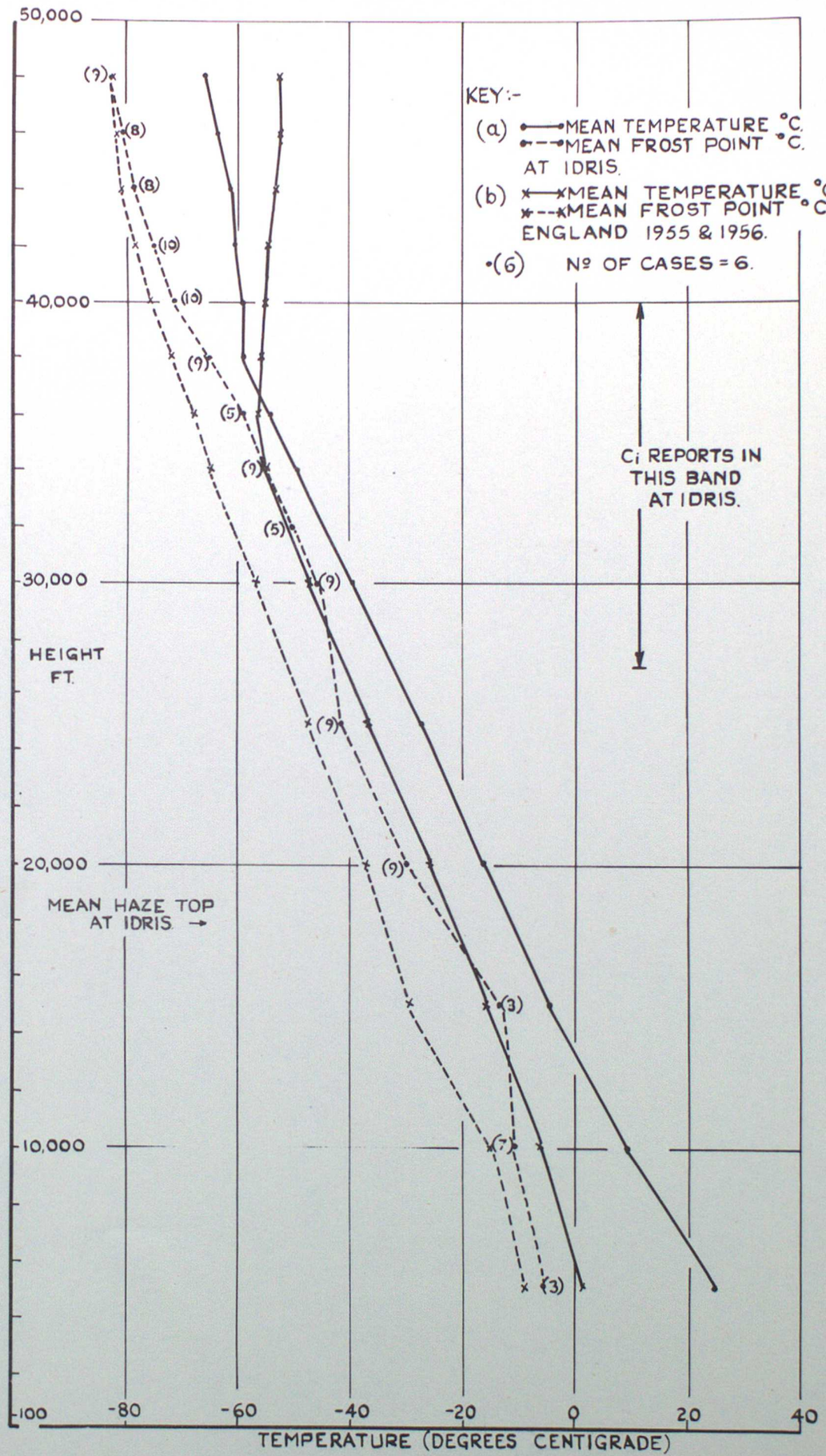
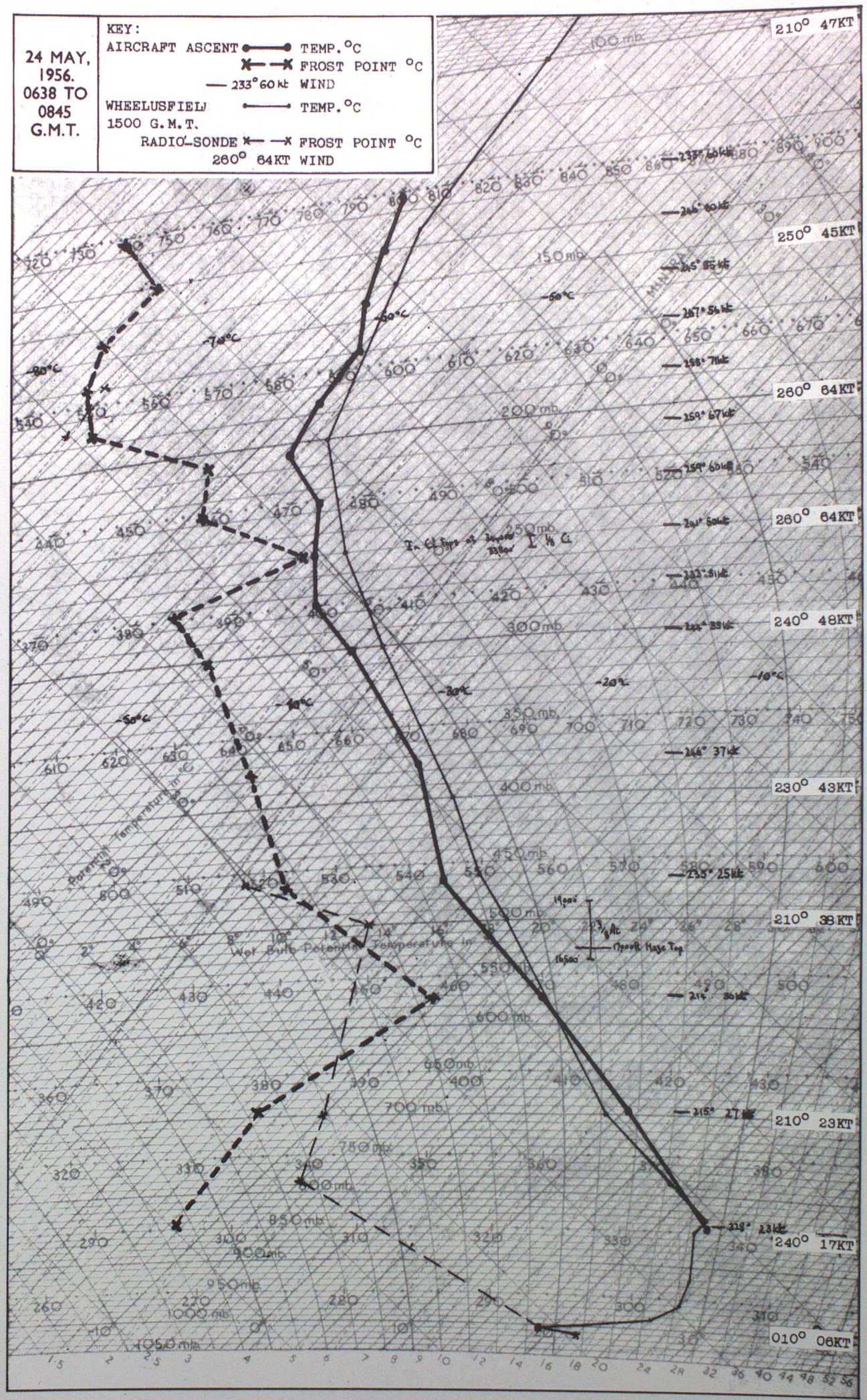


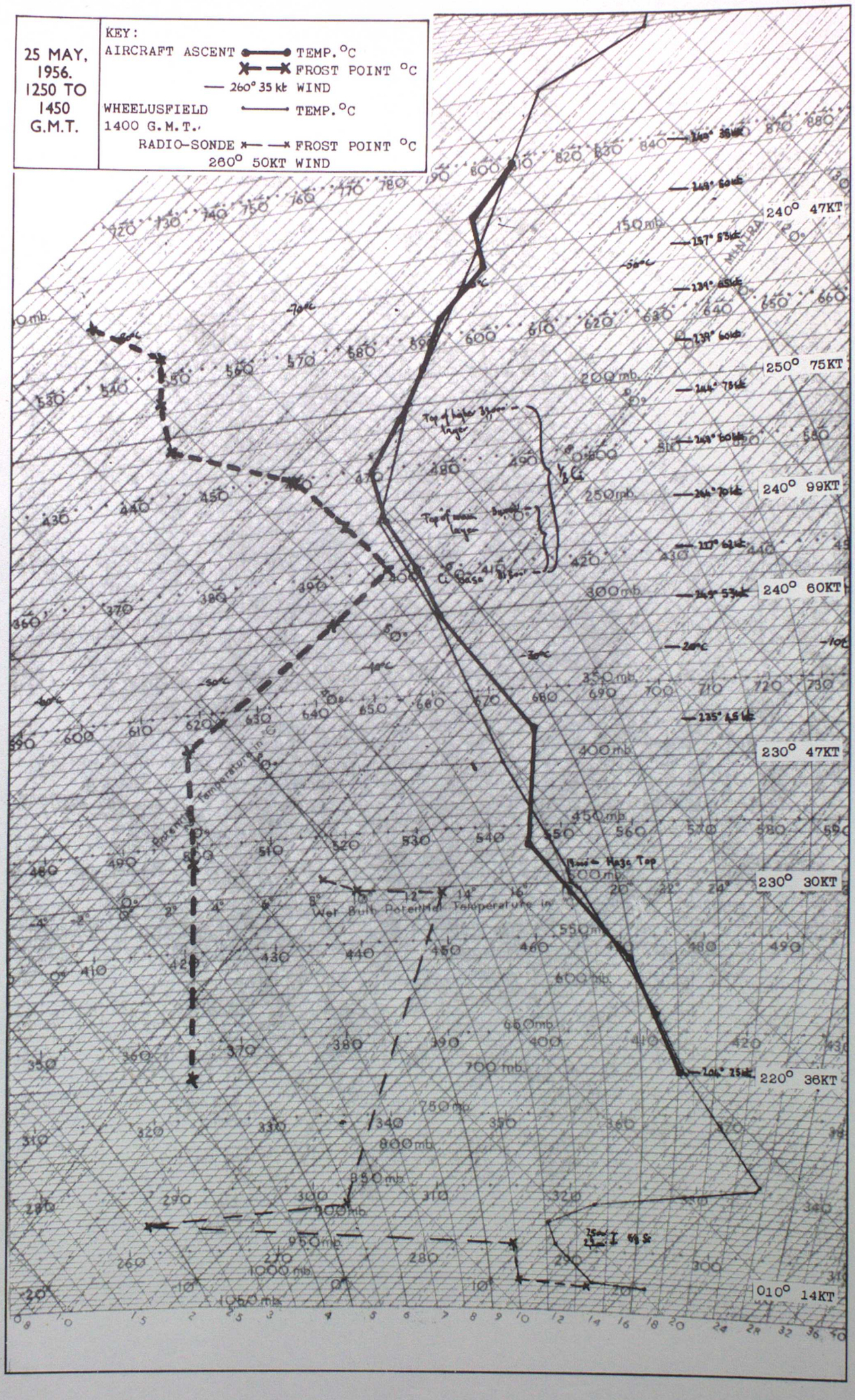
FIG. 1. MEAN TEMPERATURE °C AND FROST POINTS.

(a) OVER IDRIS 23RD MAY TO 2ND JUNE 1956.
(b) OVER ENGLAND 1954 AND 1955.



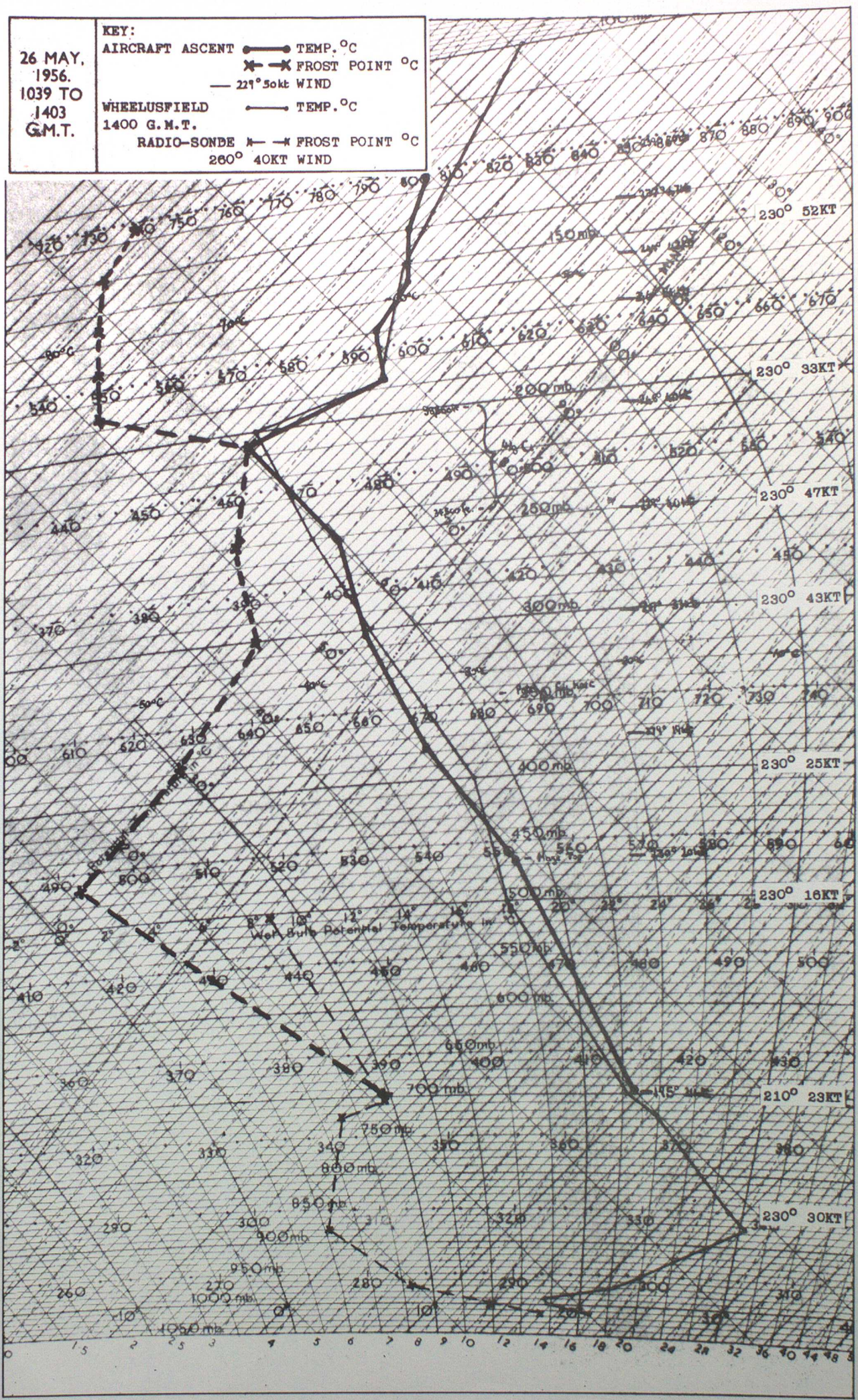
R.A.E. 129165 57

FIG.3



R.A.E. 129166 | 57

FIG.4

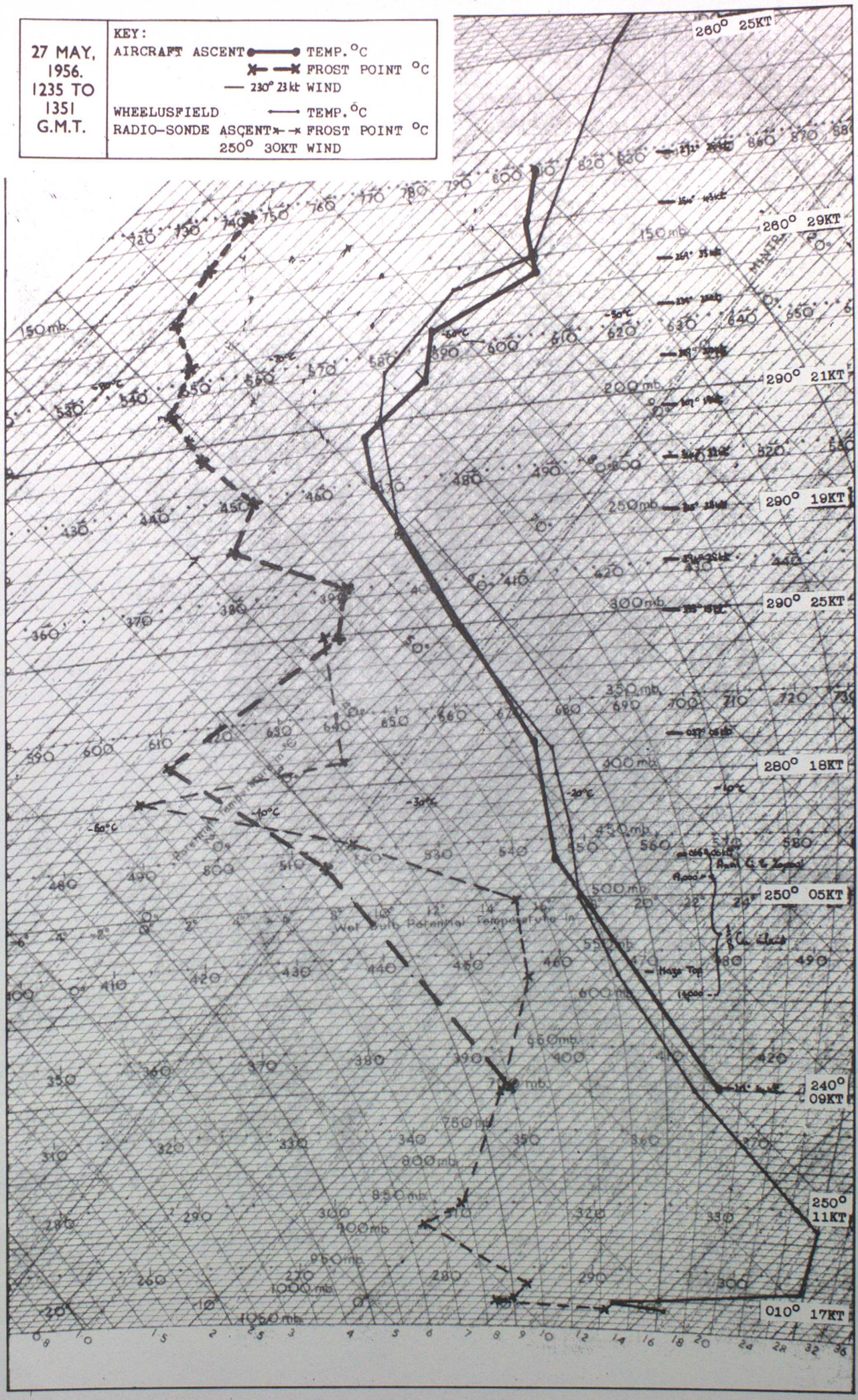


R.A.E. 129167 57

FIG.5

27 MAY, 1956. 1235 TO 1351 G.M.T.

KEY:
AIRCRAFT ASCENT —●— TEMP. °C
—×— FROST POINT °C
— 230° 23 kt WIND
WHEELUSFIELD —○— TEMP. °C
RADIO-SONDE ASCENT —×— FROST POINT °C
250° 30KT WIND



R.A.E. 12960 57

29 MAY, 1956. 1240 TO 1420 G.M.T.

KEY:
AIRCRAFT ASCENT — TEMP. °C
— FROST POINT °C
— 250° 60kt WIND
WHEELUSFIELD — TEMP. °C
1400 G.M.T.
RADIO-SONDE
ASCENT — FROST POINT °C
240° 40KT WIND

R.A.E. 129169 57

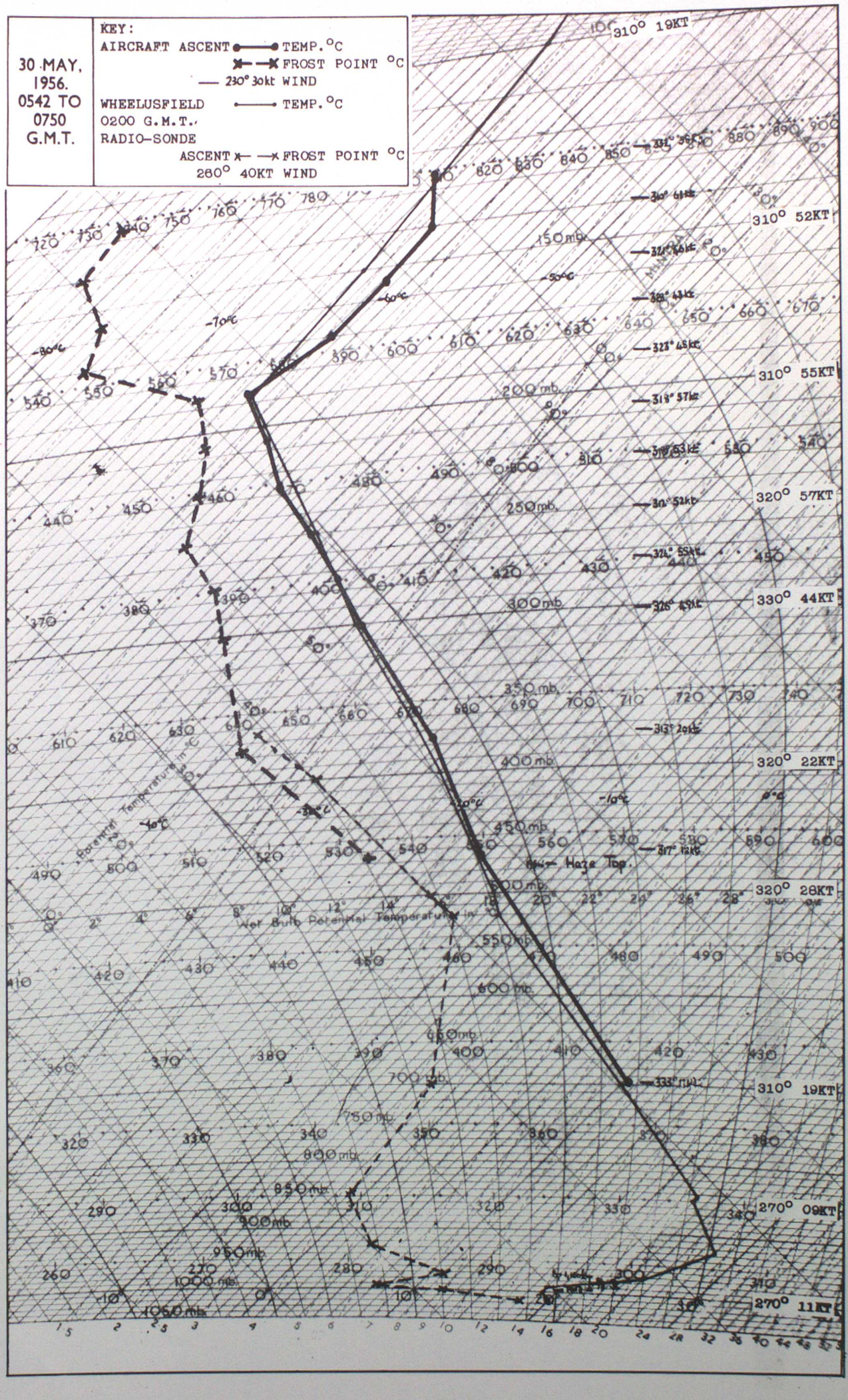
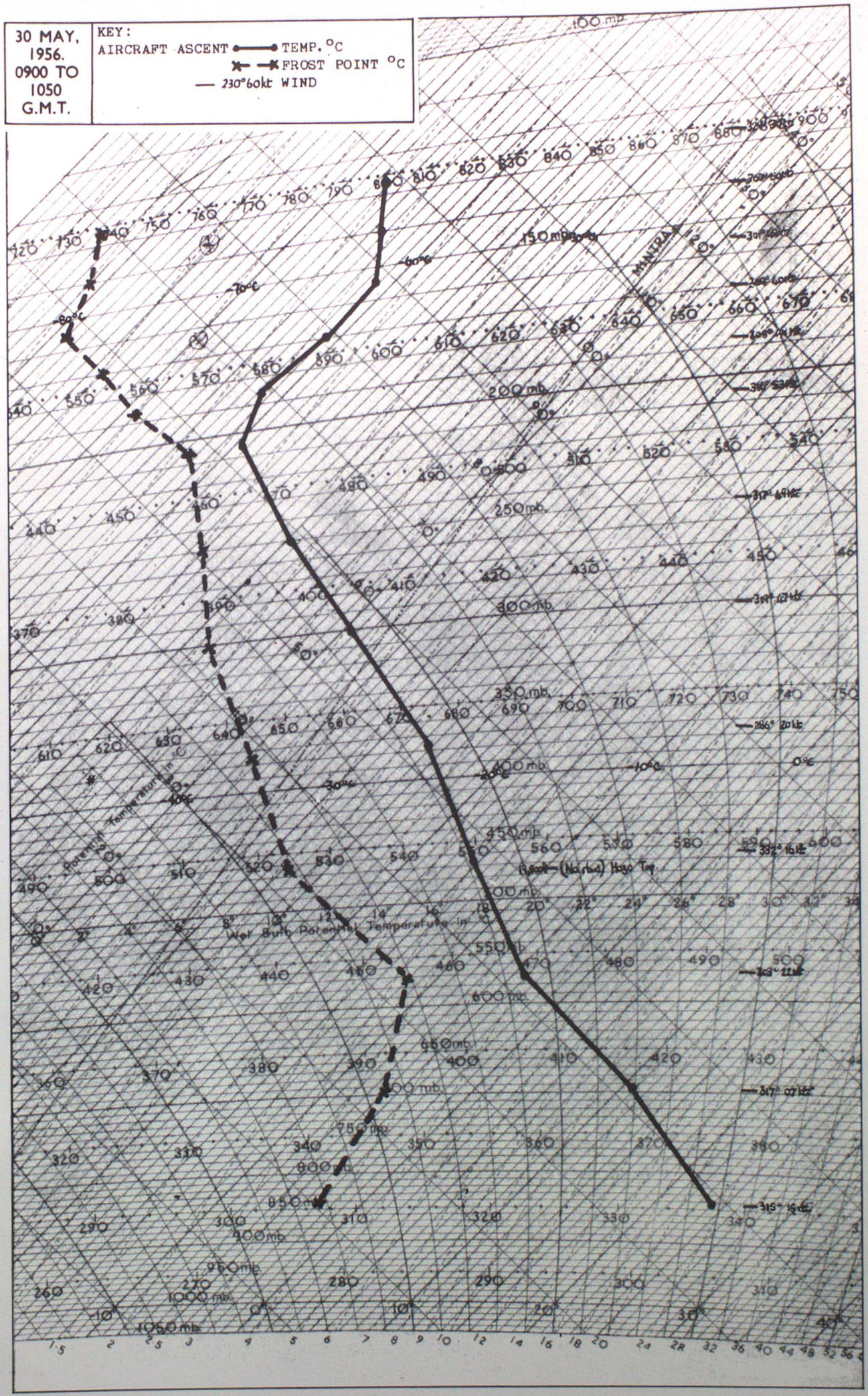

30 MAY, 1956. 0542 TO 0750 G.M.T.
KEY:
AIRCRAFT ASCENT TEMP. °C
FROST POINT °C
230° 30kt WIND
WHEELUSFIELD TEMP. °C
0200 G.M.T.
RADIO-SONDE
ASCENT FROST POINT °C
260° 40KT WIND
310° 19KT
310° 52KT
310° 55KT
320° 57KT
330° 44KT
320° 22KT
320° 28KT
310° 19KT
270° 09KT
270° 11KT
150mb.
200mb.
250mb.
300mb.
350mb.
400mb.
450mb.
500mb.
550mb.
600mb.
650mb.
700mb.
750mb.
800mb.
850mb.
900mb.
950mb.
1000mb.
1050mb.
Haze Top.
Potential Temperature in °C
Wet Bulb Potential Temperature in °C

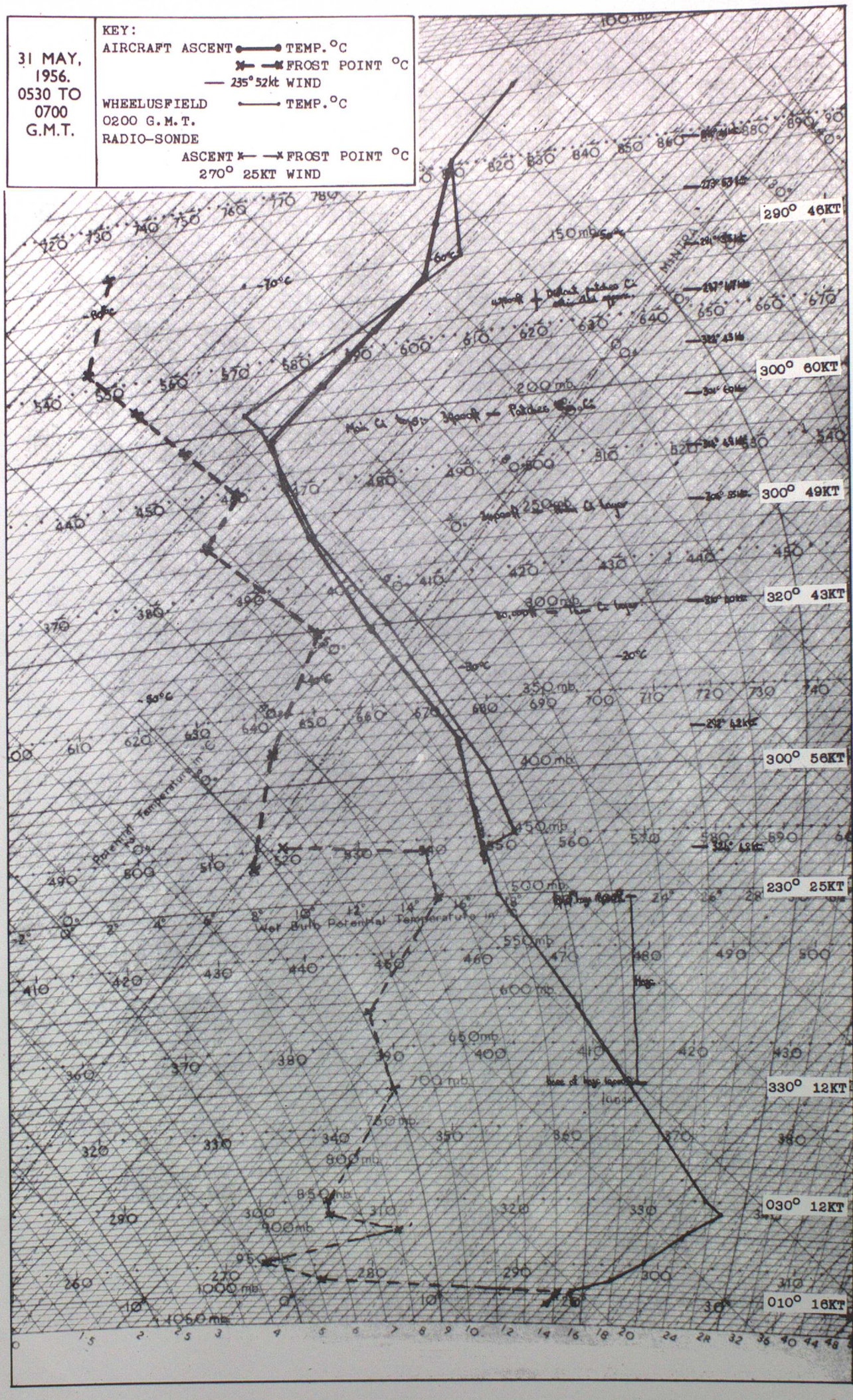
FIG.8

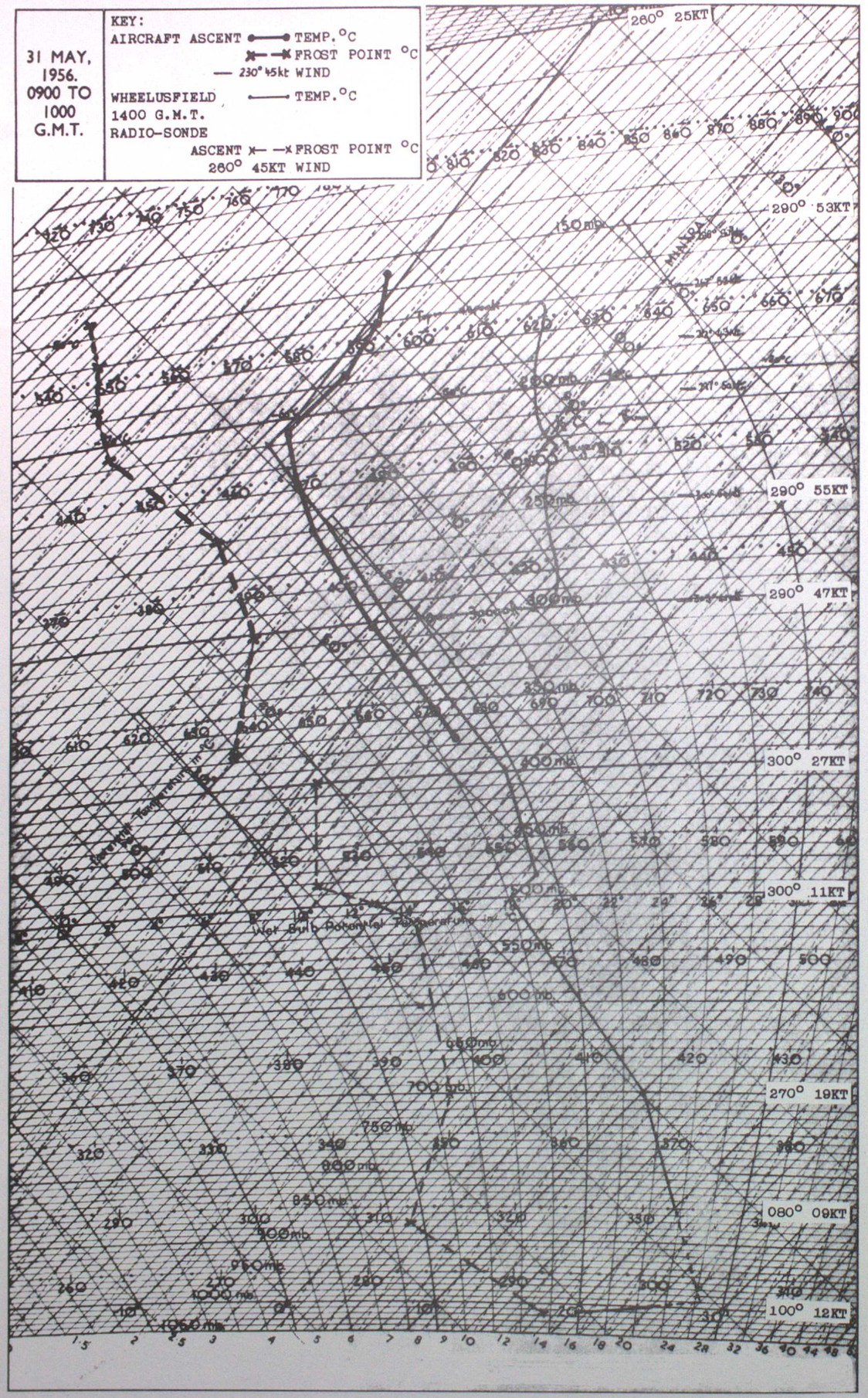
30 MAY, 1956. 0900 TO 1050 G.M.T.

KEY:
AIRCRAFT ASCENT — TEMP. °C
— FROST POINT °C
— 230°60kt WIND



R.A.E. 129171 57


31 MAY, 1956. 0530 TO 0700 G.M.T.
KEY:
AIRCRAFT ASCENT TEMP. °C
FROST POINT °C
235° 52kt WIND
WHEELUSFIELD TEMP. °C
0200 G.M.T.
RADIO-SONDE
ASCENT FROST POINT °C
270° 25KT WIND
290° 46KT
300° 60KT
300° 49KT
320° 43KT
300° 56KT
230° 25KT
330° 12KT
030° 12KT
010° 16KT
Wet Bulb Potential Temperature in °C
Potential Temperature in °C



SOME USEFUL DATA

MIXING RATIO IN GM/KG

ICAN HEIGHT FEET	PRESSURE Mb	FROST POINT, DEGREES CENTIGRADE									
		-10	-20	-30	-40	-50	-60	-70	-77.5	-80	-82.5
10,000	697	3.1	1.2	0.55	0.17	–	–	–	–	–	–
15,000	572	3.2	1.4	0.55	0.21	0.05	–	–	–	–	–
20,000	465	3.8	1.7	0.67	0.25	0.06	–	–	–	–	–
25,000	376	4.8	2.1	0.85	0.31	0.10	0.019	–	–	–	–
30,000	301	–	–	1.1	0.4	0.14	0.025	0.006	–	–	–
32,000	274	–	–	1.2	0.43	0.15	0.026	0.007	–	–	–
34,000	250	–	–	1.3	0.48	0.16	0.027	0.007	–	–	–
36,000	227	–	–	1.4	0.53	0.17	0.029	0.008	–	–	–
38,000	206	–	–	–	0.58	0.18	0.032	0.0085	–	–	–
40,000	187	–	–	–	0.62	0.19	0.034	0.009	0.003	0.00195	–
42,000	170	–	–	–	–	0.20	0.039	0.0097	0.0035	0.002	0.00135
44,000	155	–	–	–	–	–	0.044	0.0105	0.0037	0.0022	0.0016
46,000	140	–	–	–	–	–	–	0.0110	0.0040	0.0028	0.0017
48,000	127	–	–	–	–	–	–	0.0120	0.0044	0.0030	0.0019

RELATIVE HUMIDITY % WITH RESPECT TO ICE

TEMP. °C	DEPRESSION OF FROST POINT, DEGREES CENTIGRADE						
	0	1	2	5	10	20	30
+10	100	95	88	73	50	22.0	8.7
+10	100	95	85	68	44	18.0	6.8
-10	100	94	83	63	39	15.5	5.0
-20	100	90	83	62	37	12.8	4.0
-30	100	90	80	58	33	10.2	2.8
-40	100	90	78	55	30	8.5	2.0
-50	100	90	78	53	28	6.5	1.6
-60	100	88	75	50	25	5.8	1.3
-70	100	85	74	48	25	5.3	–

Geostrophic Wind Scale for Charts at 40°N.

100 50 30 20 Knots 10

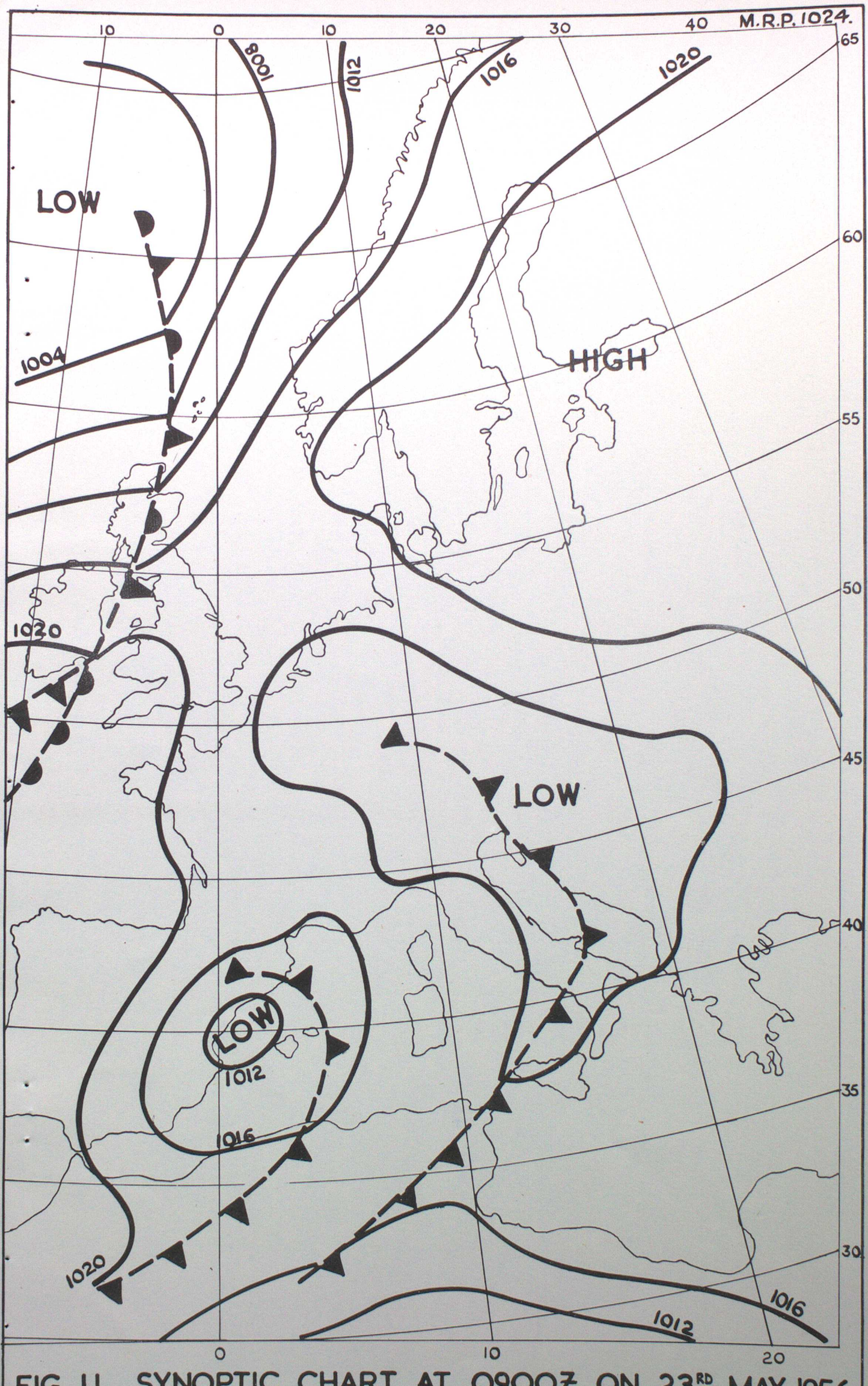


FIG. 11. SYNOPTIC CHART AT 0900Z ON 23RD MAY 1956.

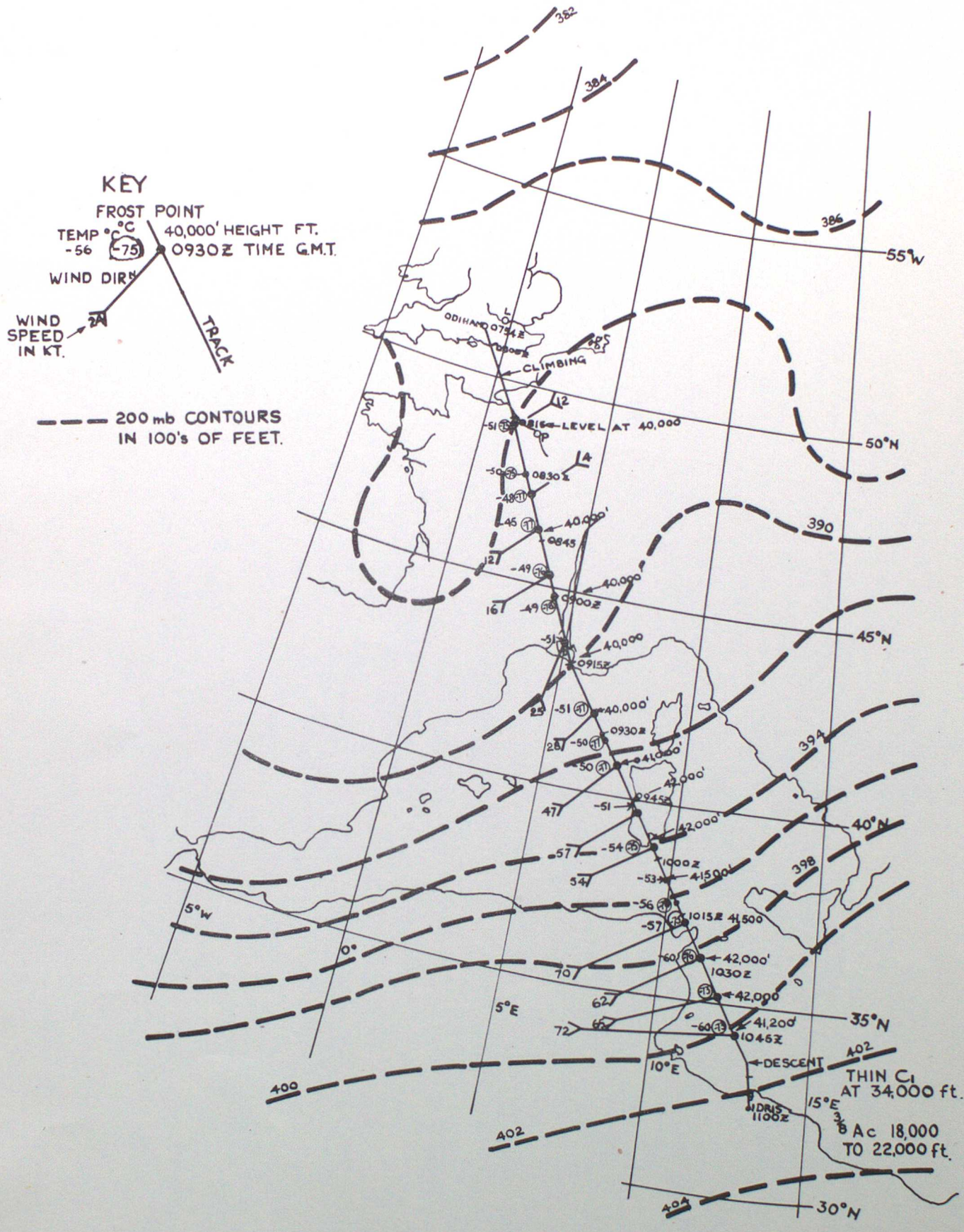


FIG. 12. FLIGHT 1 ODIHAM TO IDRIS: 23RD MAY 1956.

M.R.P. 1024.

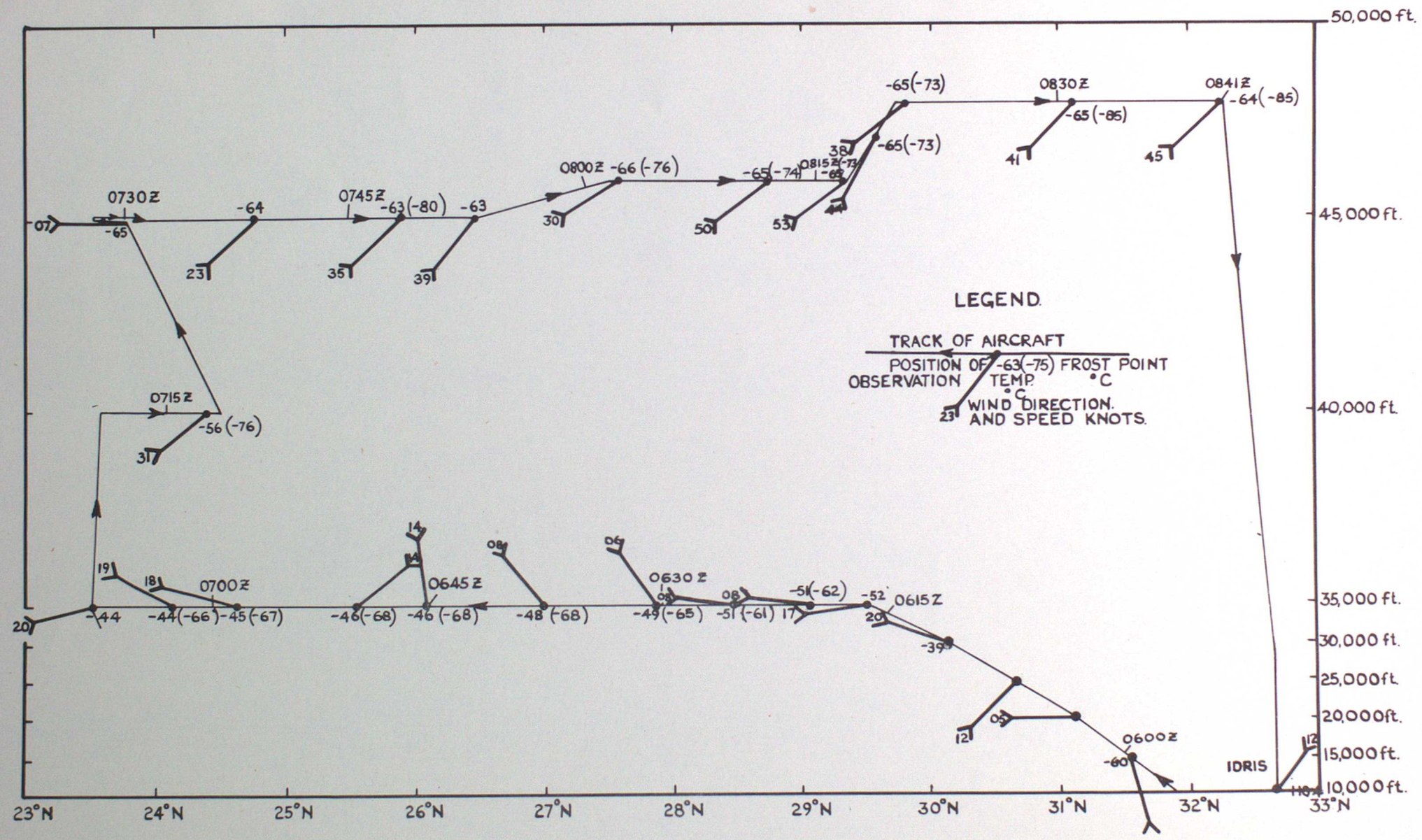


FIG. 13. FLIGHT 8: CANBERRA WJ582: IDRIS TO 23½° N AND RETURN LONGITUDE 13°E ±15'.

27TH MAY. 1956.

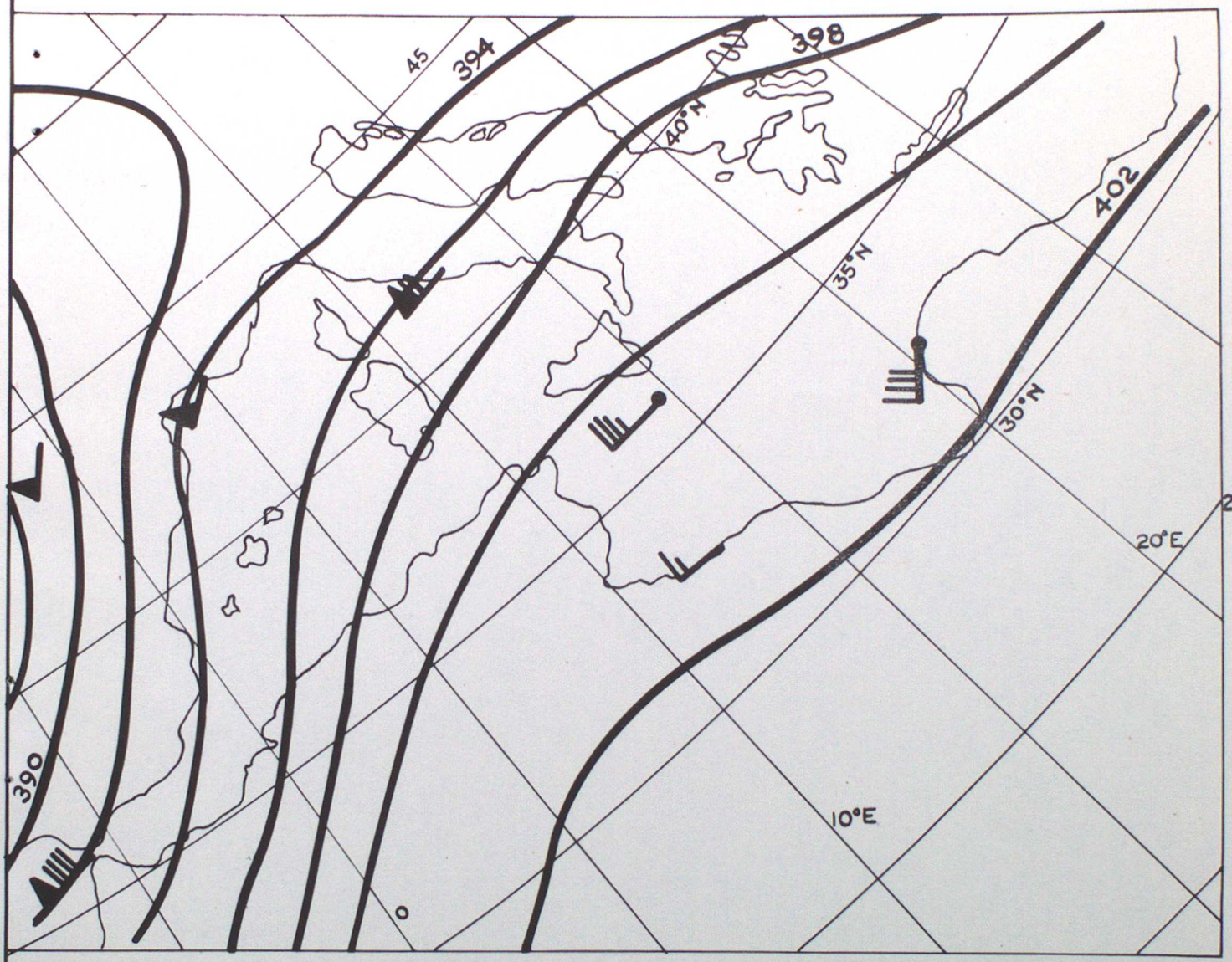


FIG. 14. 200mb CONTOURS AT 0300Z. 27TH MAY 1956.

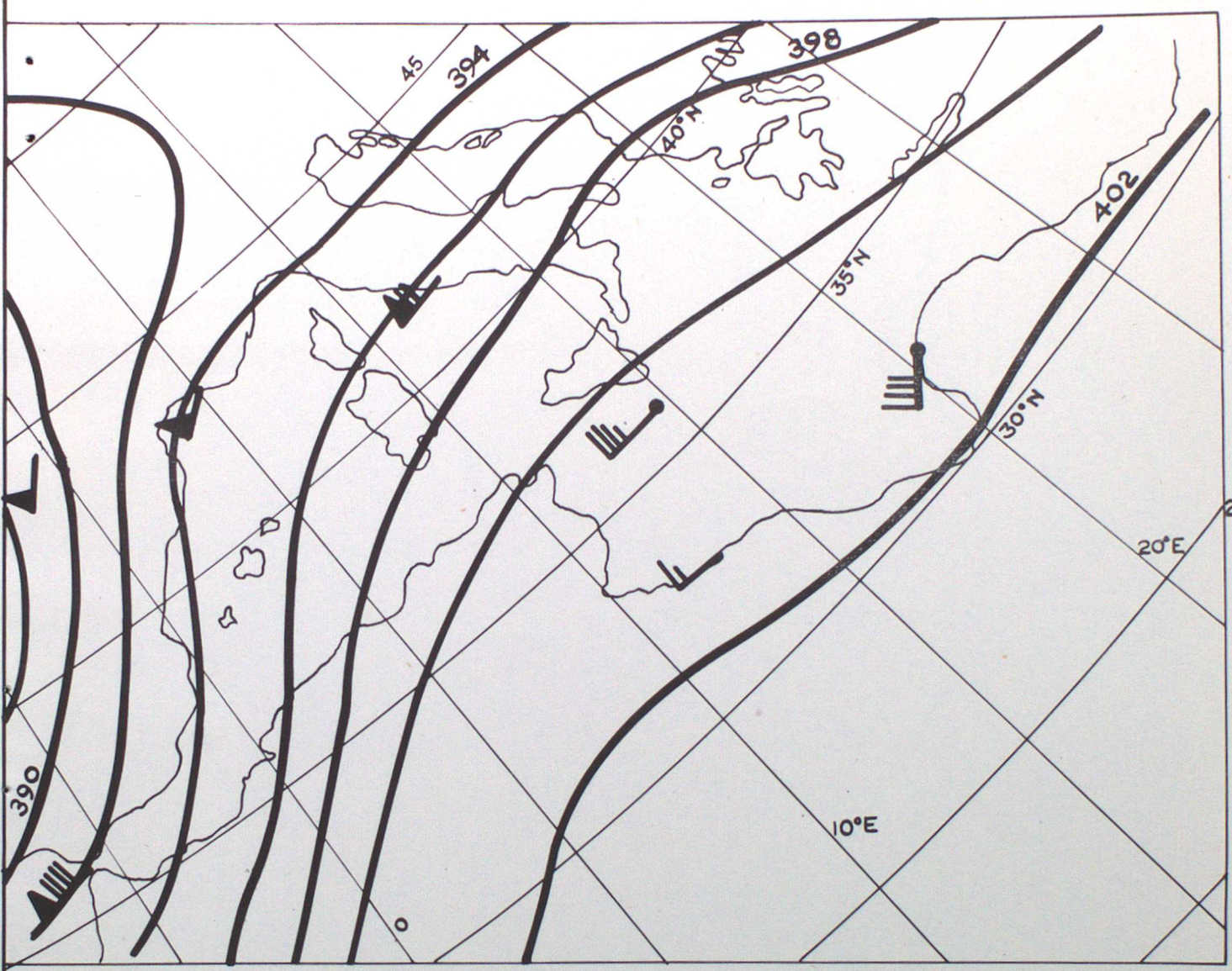


FIG. 14. 200mb CONTOURS AT 0300Z. 27TH MAY 1956.

M.R.P. 1024.

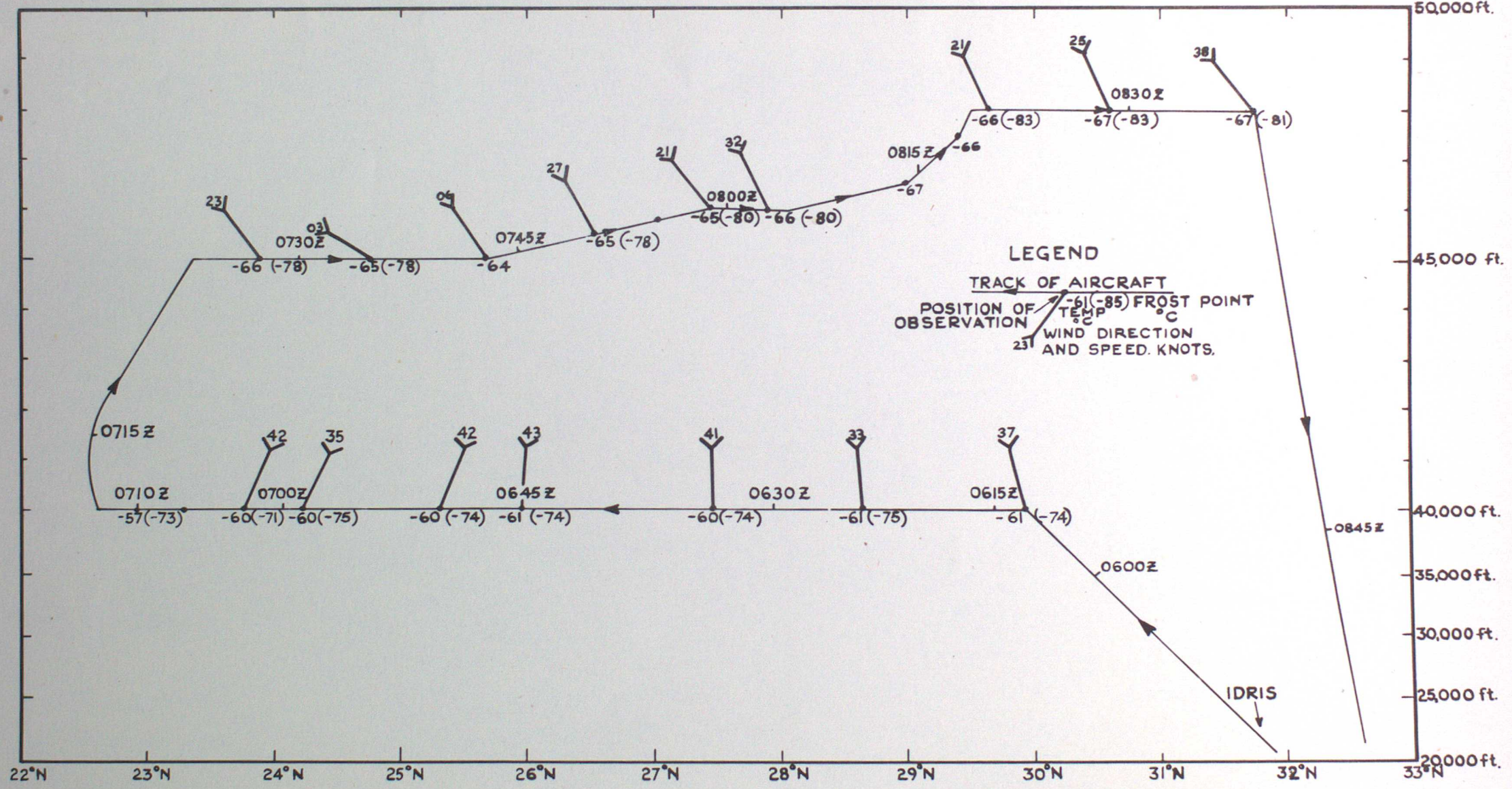


FIG. 15. FLIGHT 10: CANBERRA WJ582: IDRIS TO 22½°N AND RETURN: LONGITUDE 13°E ± 15'.

29TH MAY. 1956.

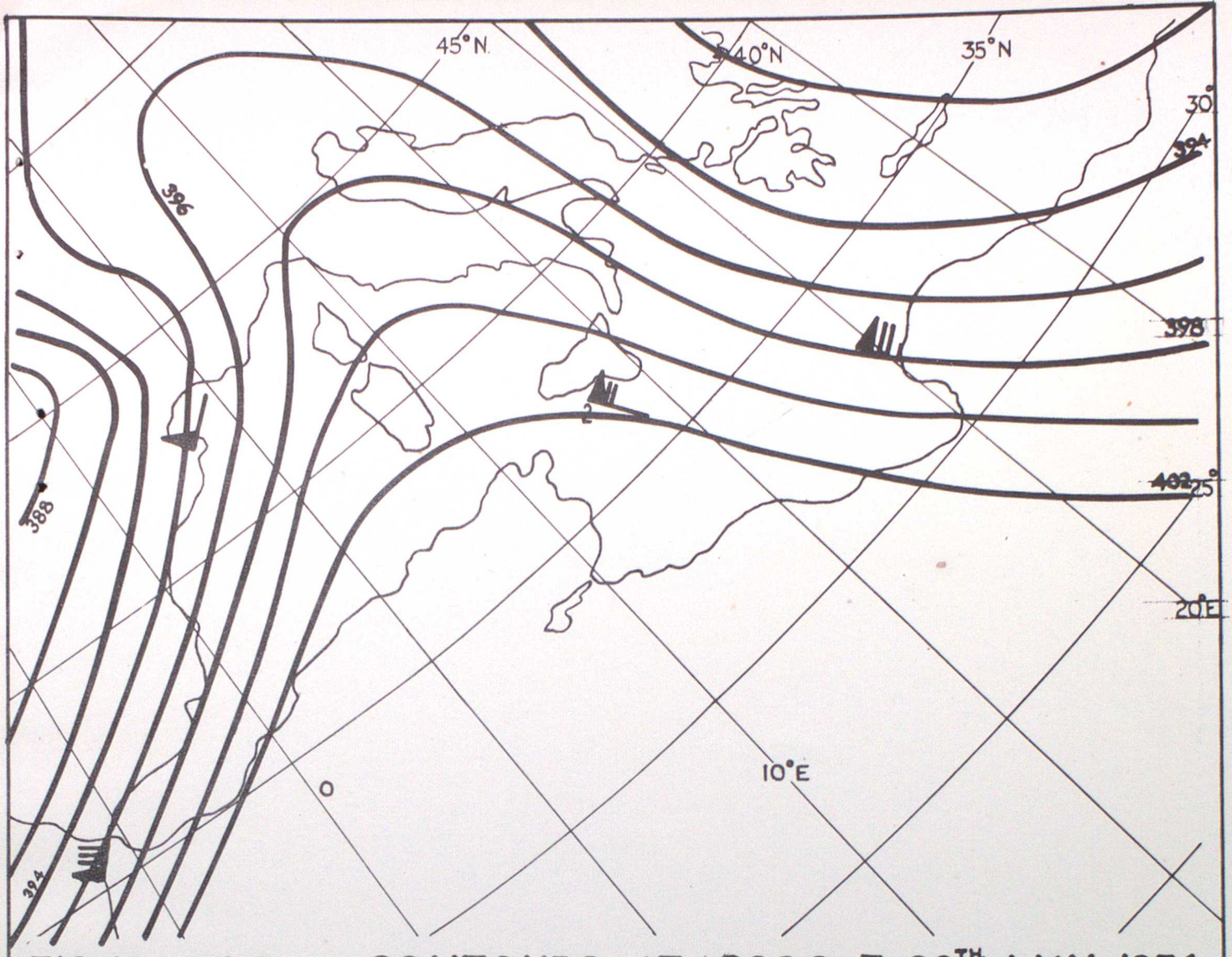


FIG. 16. 200mb CONTOURS AT 0300 Z 29TH. MAY 1956.

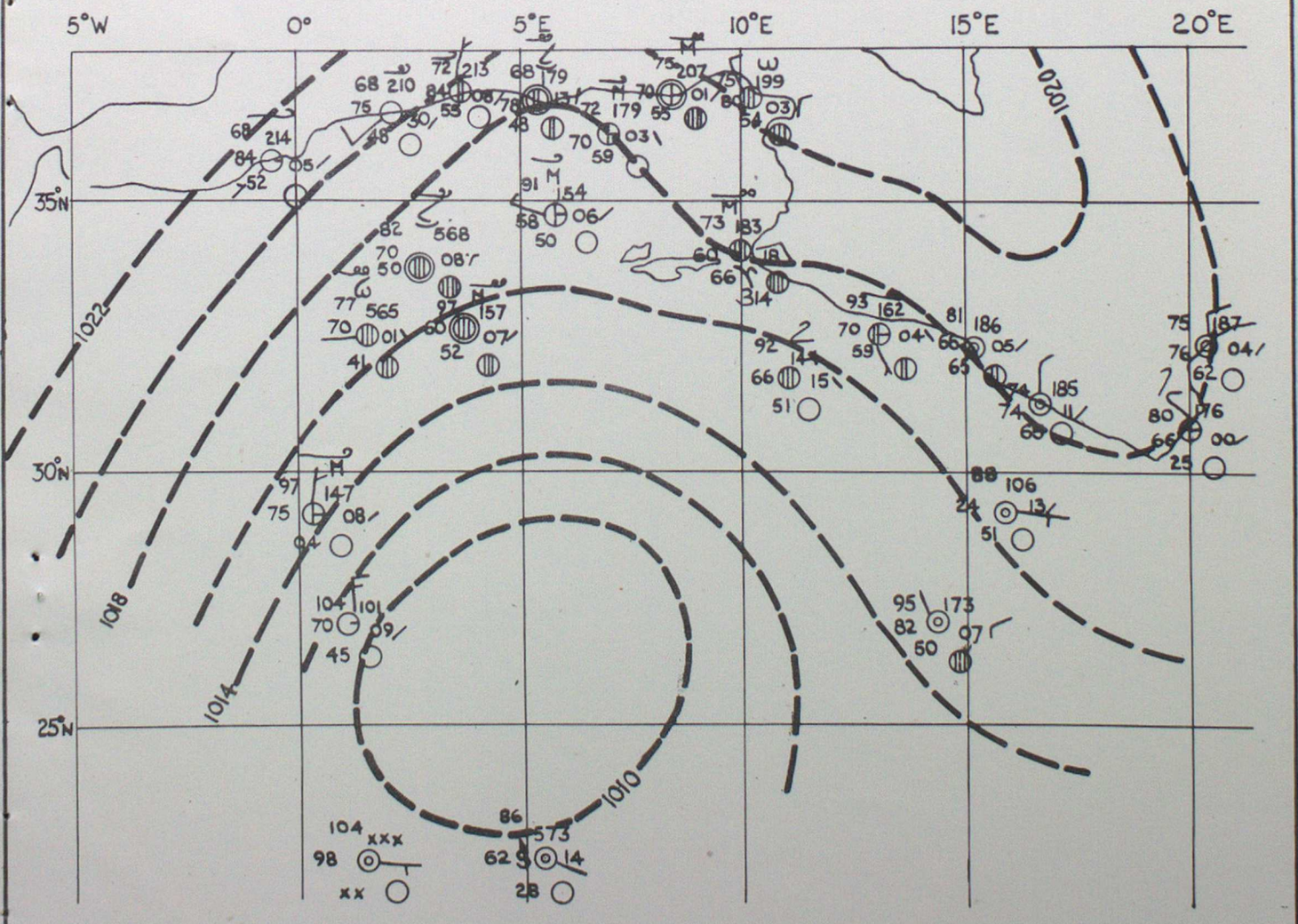


FIG. 17. SYNOPTIC CHART AT 0900Z ON TUES. 29TH MAY 1956
M.R.P. 1024.

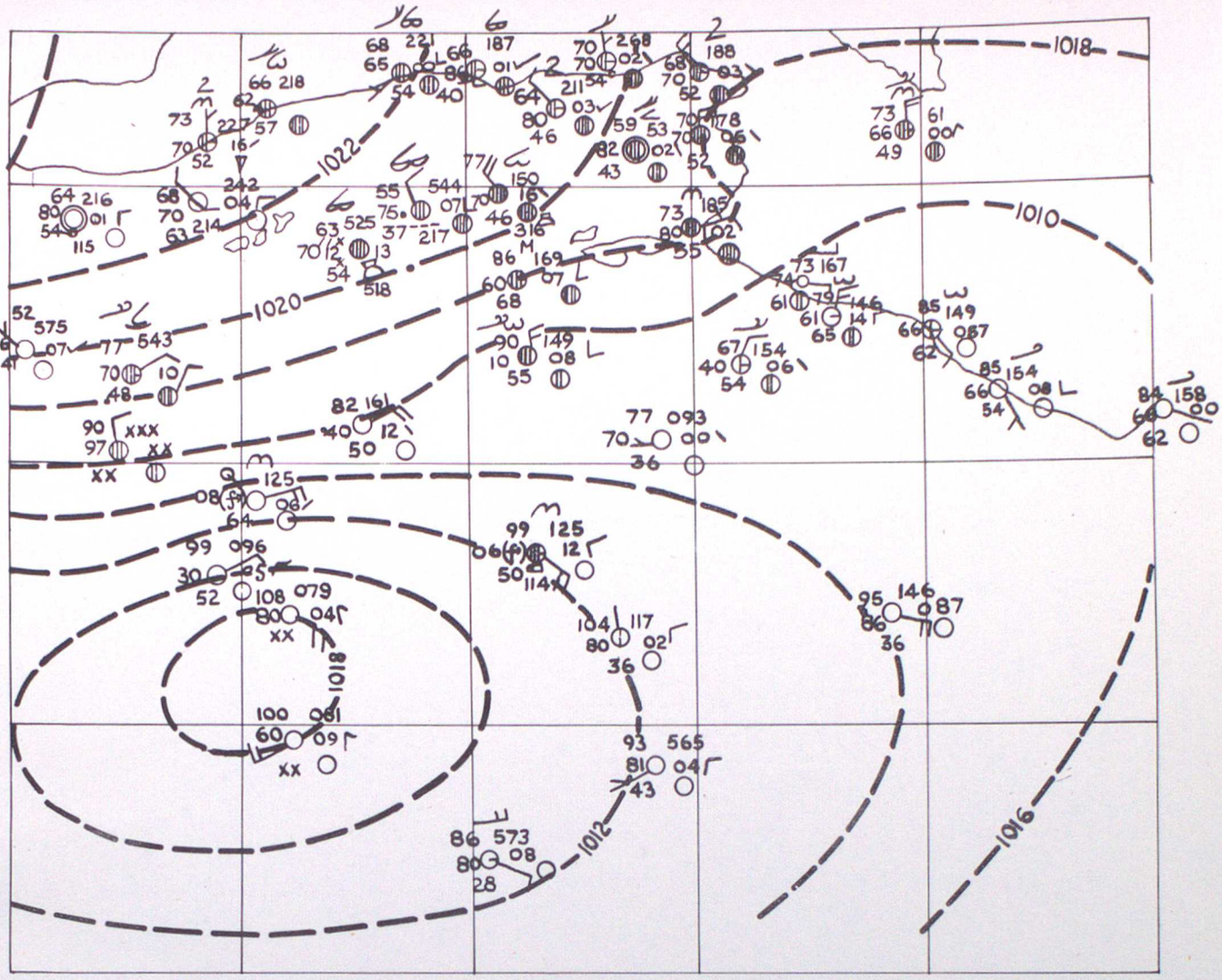


FIG. 18. SYNOPTIC CHART AT 0900Z ON 1ST JUNE 1956.

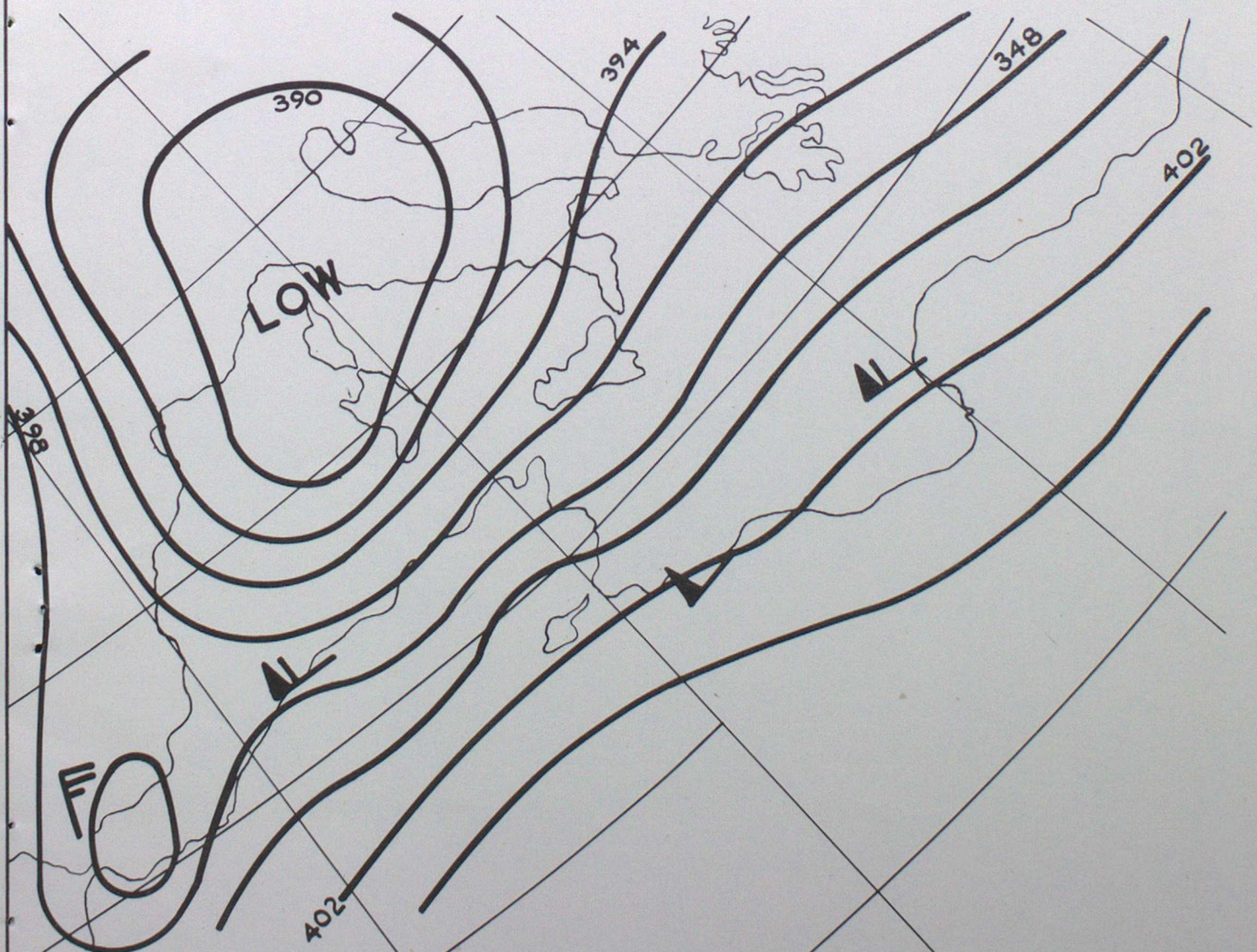


FIG. 19. 200mb CONTOURS AT 1400Z 1ST JUNE 1956.

M.R.P. 1024.

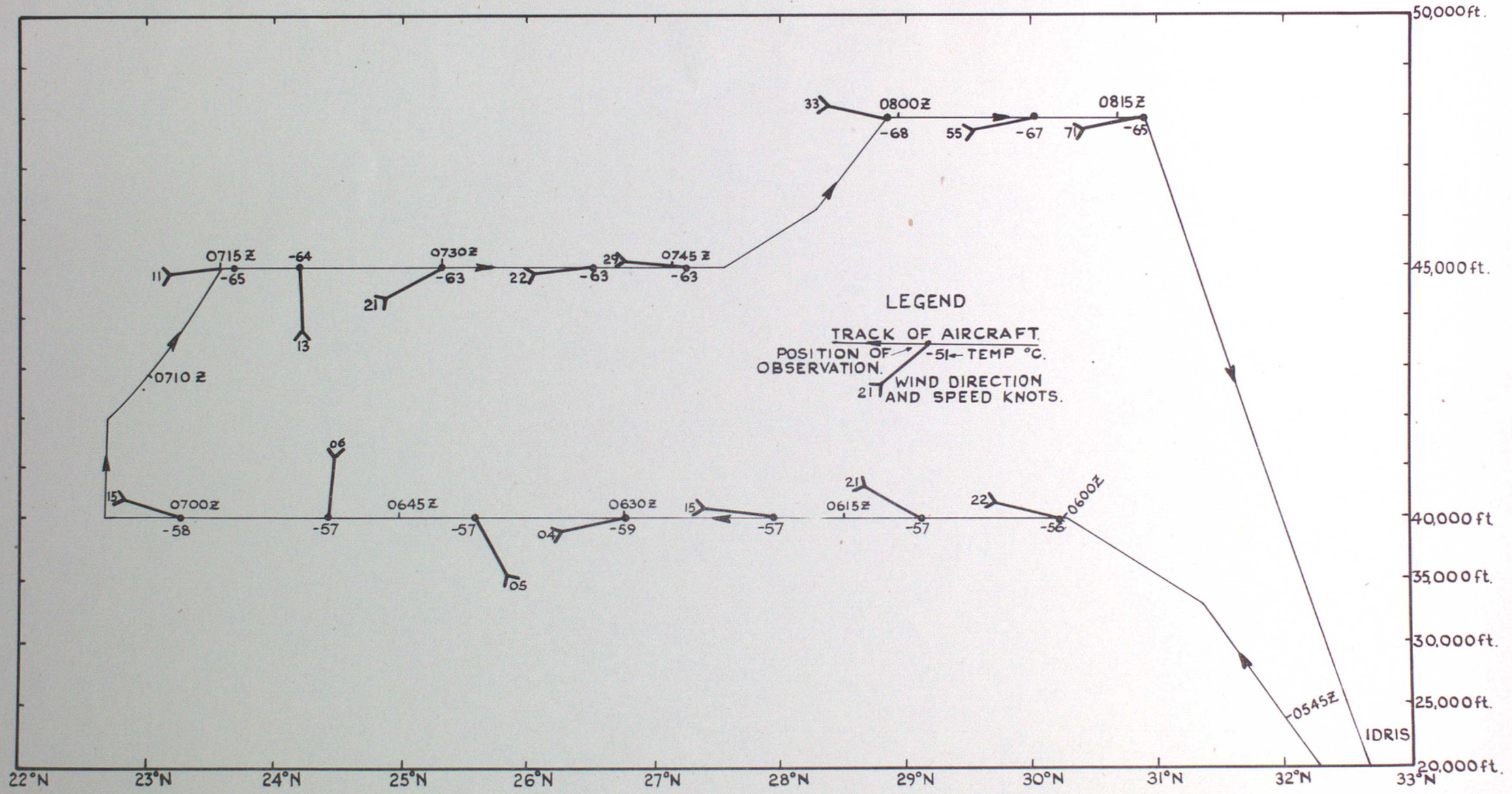


FIG. 20. FLIGHT 16: CANBERRA WJ582: IDRIS TO 22 °N AND RETURN: LONGITUDE 13°E ± 15'.

1ST JUNE. 1956.

M.R.P. 1024.

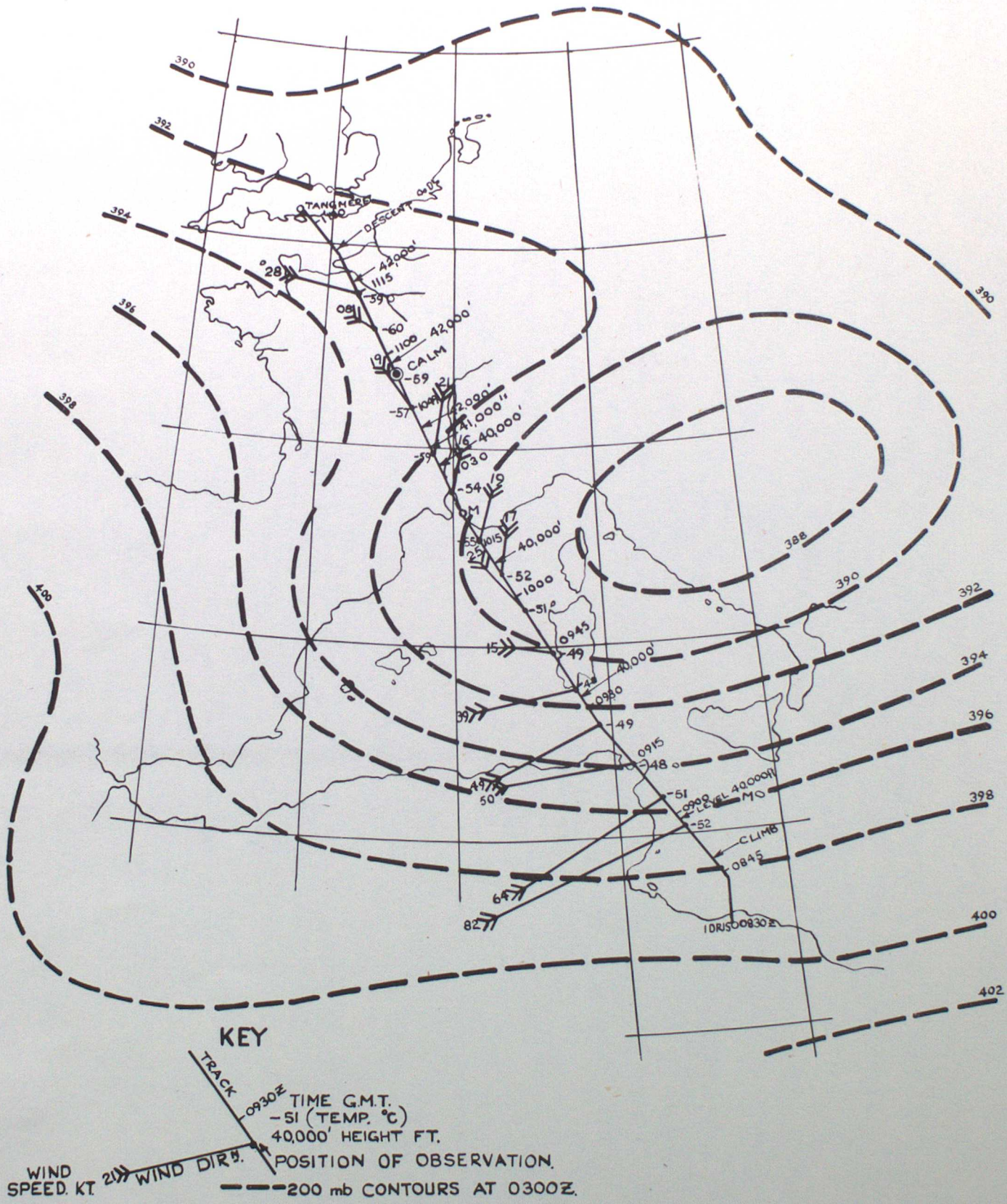


FIG. 21. IDRIS TO TANGMERE: CANBERRA WJ582 ON 2ND JUNE 1956.

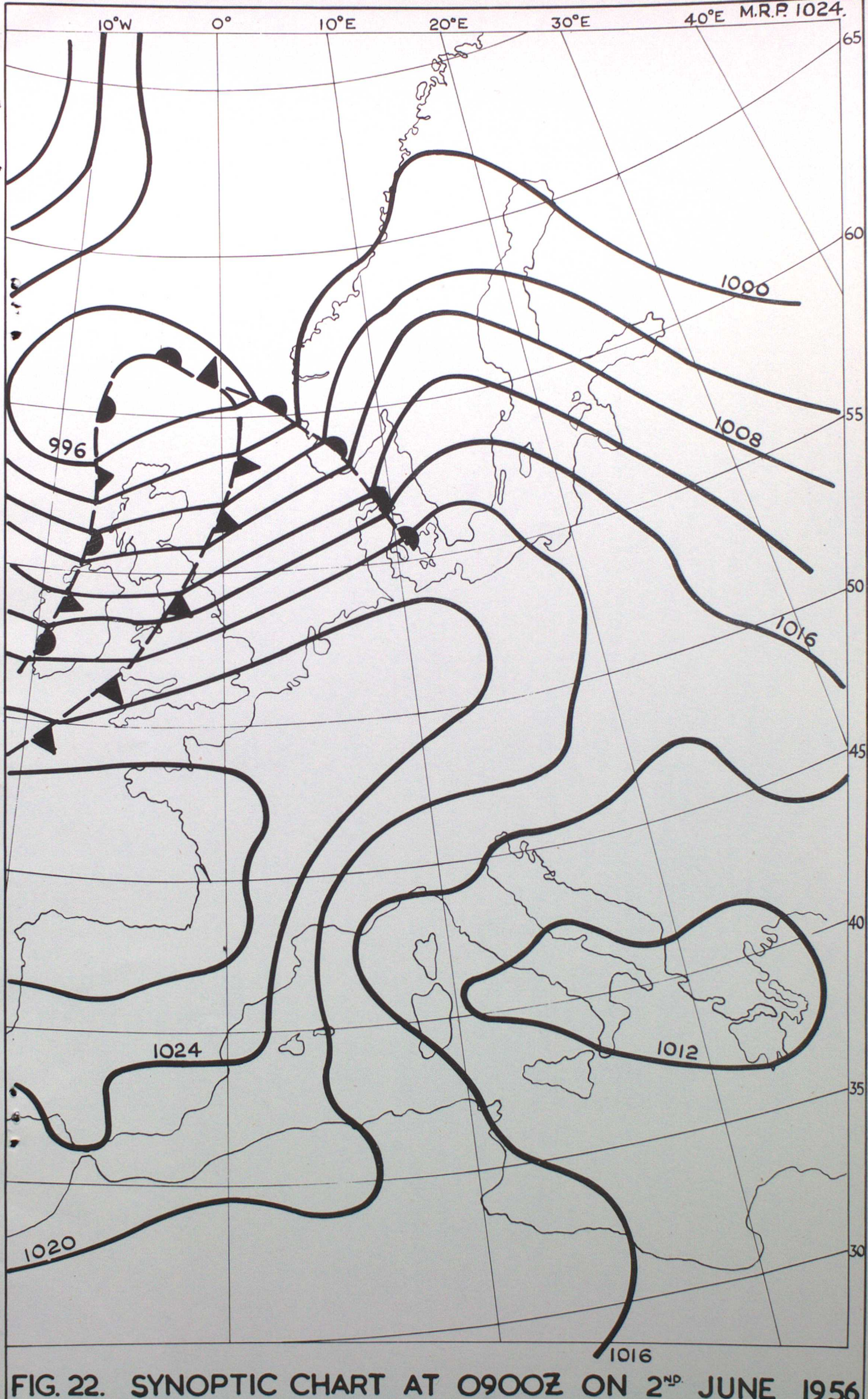


FIG. 22. SYNOPTIC CHART AT 0900Z ON 2ND JUNE 1956.